COORDINATORS: MARILENA ONETE, MIHAELA ION

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COPERTA: MIHAELA ION

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Autors in alfabetical order:

Ioana Cobzaru
Institute of Biology, Bucureşti

Rodica Gheorghe
Urban and Metropolitan Planning Centre, Bucureşti

Mihaela Ion,
Institute of Biology, Bucureşti

Marilena Onete,
Institute of Biology, Bucureşti

Mariana Nica
Urban and Metropolitan Planning Centre, Bucureşti

Mihaela Paucă-Comănescu
Institute of Biology, Bucureşti

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FOREWORD

In the last century the urban population growth, climate change, etc. increased the loss of biodiversity all around the world. In all cites from the planet, due to industrial plants, power plants, domestic heating and especially motor traffic, air pollution is the major environmental problem. Increased concentrations of air pollutants and the variety of pollutants have negative effects on the increasing population density in the relatively small area of a city. Air pollution harms not only human beings but also plants and animals living together in the city.

A multidisciplinary and trans-disciplinary approach of the air pollution in Bucureşti, first time realised in Romania, having a huge scientific and practical importance, have been carried out in the framework of LIFE-Environment project: "AIR Pollution ImpAct Surveillance and Warning System for URban Environment" (LIFE05ENV/RO/000106) (Acronym: AIR-AWARE) coordinated by Meteorological Nation Administration, having as partners: Environmental Protection Agency, Bucureşti; Urban and Metropolitan Planning Centre, Bucureşti; Public Heath Direction, Bucureşti; Institute of Biology, Bucureşti and Meteo France.

In the framework of LIFE AIR-AWARE project the team from Institute of Biology, Bucureşti, had been realized the assessment of plant and animal species and the evaluation of impact of air pollution on some species/groups of plants and animals from Bucureşti in the pilot area from the centre of Bucharest (Romania). The area comprises one complex park (Cişmigiu) treated as a complex of ecosystems and other two parks (Izvor and Unirii) as much simplified ecosystems with different degrees of management. In situ research (passive methods) had identified the diversity of vascular plants from a major urban centre from Romania and the potential bioindicators of air pollution. There is a shortage of available data for plants in Bucharest and many studies have been realized at the outskirt of the city.

This book presents the importance of green spaces in urban environment and human health. Urban green areas are very important components of a city's infrastructure. Parks and gardens enrich the lives of citizens (for resting and reducing stress, anxiety), buffers for air and water pollution and also offer places to see wildlife. The loss of natural land in favor of urban areas has resulted in the diminution of the natural habitat and biodiversity of species. Park management regimes and the variety of park habitats can affect the abundance and diversity of native species. Wildlife conservation in urban habitats is increasingly important due to current urbanization trends. The green spaces from the cities have been created for people to enjoy. In these scattered habitat patches exists the potential for wildlife. An effective planning strategy is needed to create corridors for linking these isolated patches for conserving the species that leaves together with humans in urban areas.

In Bucureşti the rate of urban development continues to increase. As much the town expands, as higher is the loss of biodiversity. If we can't recreate the lost natural ecosystem, at least we should try to make urban habitats more suitable for a range of species. Storing chemicals in their bodies, plants (trees, shrubs, herbaceous) help us,

human beings, by cleaning our air. They can live without us, even better than in the environment polluted by us. We cannot live without them. Without a clean air we cannot survive. In our life, rushing every time, how could it be to not see, at least for a moment, any green space in our way? Seeing the beauty of a flower, smelling it, our hearts fill all the time with tender. Even we cannot see the invertebrates beneath our feet in the soil, or hidden in the vegetation, they are there and play their vital role in nature. As long as we keep the vegetation in smaller or bigger (preferably complex) green spaces in the city, these living organisms will live their lives and bring a huge contribution to ours.

The multidisciplinary approach leads to the awareness about the importance of maintenance of already existent green spaces, increment of their structural complexity and establishment of new ones, the development of some methods and ideas presented in this book, for helping the municipality in planning and realising environmental management.

BRIEF HISTORICAL DEVELOPMENT OF BUCUREŞTI CITY

Marilena Onete

The historical development of Bucureşti city have been written using data published by Giurescu (1979), Bacalbaşa (1987), Croitoru & Târcob (1985), Majuru (2003).

The forest zone between the Ialomiţa and Danube rivers together with the Bărăgan and Burnaz steppes, are irrigated by numerous rivers and dotted about with lakes and meadows, consequently offering optimal conditions for human life. From prehistory onward, the Bucureşti area, situated within this zone, had a widely spread human population, with the most numerous early human settlements being in the Colentina and Ialomiţa river valleys (Figure 1).

Along centuries, the inhabitants of the Bucureşti area had agriculture as a major activity, together with animal husbandry, hunting and fishing. During of Greek (Phanariot) rule on behalf of the Ottomans, Bucureşti became the political, administrative, commercial and economic centre. The modernisation process which began in 1806-1812 was in full development by the middle of the 19th century. A Russo-Turkish war occurred from 1828-9, resulting in Wallachia (and Moldavia) becoming Russian protectorates. The streets were paved with stones from the rivers, the boulevards were bordered with lime (linden) trees and all thoroughfares had lamps. The urban process of urban renewal and street improvement (paving, trees *etc*) took place mainly from 1834-1842. Fountains with filtered water from the Dâmboviţa River were installed, including in 1847 some with playing waters on Kisselef Boulevard, which was begun in 1832 with limes on both sides. In 1843, the German horticulturist Meyer and his assistant Hörer made a park with trees and shrubs brought from Italy at the entrance of Kisselef Boulevard. Foreign travellers wrote that on the both sides of the Boulevard there was a public garden, one of the most beautiful gardens from Europe. At the same time, Cişmigiu Garden, a lovely park in the city centre, was laid out. A lake, on whose waters wild ducks used to rest, was drained and the surrounding fields were arranged by the same Meyer, and in 1846 one could talk about the "garden from the city centre". Many public and other buildings were built during this time. The city centre acquired the façade of a western city, or at least that part inhabited by rich people, where the streets were paved with stone, the fountains had filtered water, with great buildings and luxurious shops. In the rest of the city suburbs, conditions were much the same as they were before.

In 1850 were embellished the city with new cemeteries, new bridges over the Dâmboviţa River and the National Theatre (opening in 1852). In Pantelimon, at the edge of the city, mulberry tree plantations were created for silkworms.

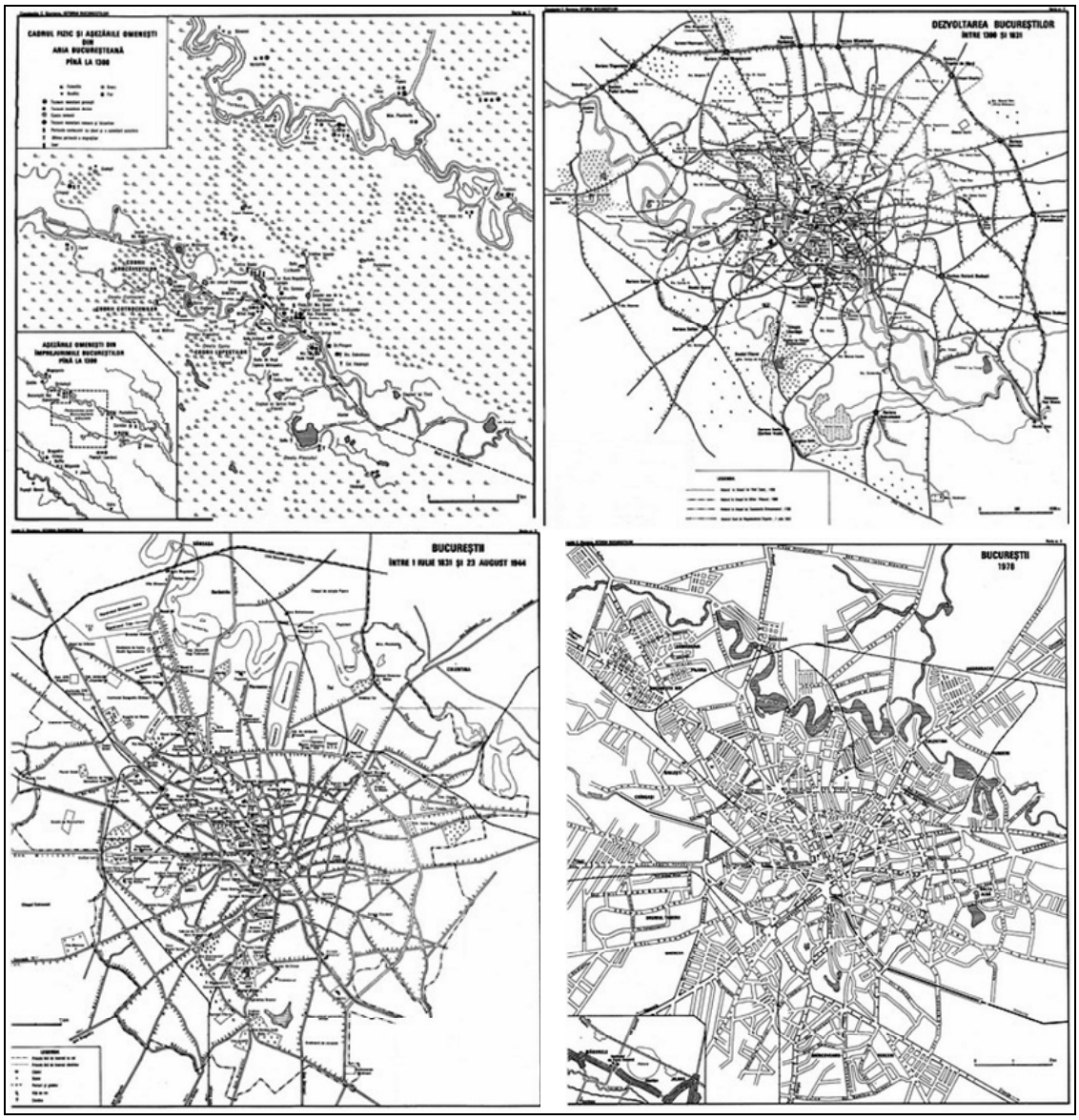


Figure 1: The development of Bucureşti city from 1300 (up left) to 1831 (up right), 1944 (down left) and 1978 (down right) (after Giurescu, 1966)

Following the unification of the provinces in 1862, Bucureşti became the sole capital of the united country of Romania. Foreign travellers were impressed by the beauty of the gardens, not only the splendid gardens of the nobleman but also the public gardens, stating that no other city, except Paris, could compare and that Cişmigiu excelled everything that Germany could offer. Bucureşti was a wonderful, interesting city of striking contrasts but, together with these contrasts, it was a city undergoing full development, in which life in all its aspects strongly pulsed.

A considerable increase in population and urban area occurred, without any precedent till then, and included much city improvement. The capital of a united

country, Bucureşti became enriched with new institutions (especially for education), industry and trade increased, and the welfare of the people also increased. The human population increased, but with high mortality explained by the precarious hygienic and sanitary conditions. Dâmbovița was not yet fully canalised and floods created unhealthy areas. The city had no drainage networks and sewage created areas favourable for infection, with many people drinking water from polluted wells. In 1870s, it was said about Bucureşti that it seemed to be submerged in gardens. Although the city had an absolutely European aspect, its particular character consisted of a melange of European and Turkish features. During the years following Romanian independence, large communication roads were cut, numerous further public and private buildings were constructed and (an essential fact) industry entered a new stage of development characterised by increased penetration of foreign capital. As the town grew continuously in area and population, new districts appeared both inside the town replacing old slums, and at the periphery of the town.

In 1871, the iron-rich springs of Văcăreşti were discovered, but they had dried up after complete canalisation of the Dâmbovița. The work of straightening and deepening the Dâmbovița River began in 1880 (finished in 1883) in order to protect the town from flooding. Straightening of the Dâmbovița River involved cutting off some bends of the river, so that some places that originally were on the left side of the river ended on the right side and vice versa, and the secondary branches of the river and the islets disappeared. After the riverbed was deepened, the meadows dried out, no more ponds were formed and the health of the city population benefited from this. A new wide network of sewers was dug, taking the household waste water and the rain water towards the river, whose level had been much lowered. In parallel to this river and sewage engineering, other work meant to provide a higher flow of drinking water went ahead, both from the Dâmbovița River and by intercepting the rich springs around the city. Exploitation of the springs took place between 1891 and 1899, using the expertise of both Romanian and foreign specialists, with the aim of increasing the amount and quality of water available to the city. Water consumption had increased due both to the denser population and their greater demands. The requirement for public utility water had also increased (*e.g.* street washing, artesian wells and limited supply especially in the central part of the town), as well as the requirements of water for developing industry.

Modernisation continued to accelerate. After 1879, the new boulevards that had been cut through the town were paved with granite stones or with grit stone.

The city expanded not just in area, but also in height. The phenomenon started after 1860. The process of new buildings and districts to replace former slums continued as well as on waste land and on the dry land that emerged when the pools in the Dâmbovița meadows were drained. Some waste ground was devoted to public gardens (Ioanid Park) or private gardens (Filipescu Park).

In 1916, when Romania entered the First World War, the city started to acquire an industrial character, which was further enhanced between the two World Wars and particularly after 1944. French visitors from 1905 spoke of the "*cheerful character of the city flooded by vegetation, with endless streets on which the cottage dwells next to villas and the spectre of the cottage is overwhelmed by the illusion of the palace*".

The luxury and tidy look of the central area contrasted with the slums with their mud and dust, no sewers, and houses that were often unhealthy.

Between the two world wars Bucureşti experienced an extraordinary and unprecedented development, particularly in terms of economy. Industrialisation progressed strongly; the city became an important industrial centre with heavy industry.

Within a largely agricultural country, Bucureşti became an example of industrial development. New industries evolved (chemical, electro-technical, aeroplanes, vegetable oils *etc*) with considerable development of the town both in area and population. The increasing density of the population (many more people on an only slightly larger area) is explained partly by the fact that houses were built on waste land inside the old perimeter ("infilling"), and partly by the increased height of the buildings. New districts appeared and the older ones were completed; whilst parks appeared and disappeared, and new boulevards and streets were opened. 2-storey villas for the bourgeoisie were built in the parks, surrounded by "green space". Districts were established beyond the city limits; and new, suburban settlements were established, which later tended to merge with the city.

Municipal works attempted to keep pace with the increase in the area and population of Bucureşti *e.g*. the even greater requirement for potable and industrial water. The amount of water supplied was insufficient for the demands of Bucureşti, particularly in summer. Artesian wells tapped underground sources of water and increased the flow rate of the Dâmboviţa River. In 1939, construction began of a diversion channel from the Argeş River west of Bucureşti; the water was brought by an open channel (22 km long) to the Rosu commune and thereafter brought into the city. The works were finished in 1950. Deep wells (160-230 m) were dug even within the city, supplying excellent clear water. Small drinking water fountains were built, and were much appreciated by the citizens during the summer. The sewer network for household and industrial waste water developed further. Unfortunately, the Dâmboviţa itself became a true sewer, the water being polluted by the oily residues from the Grozaveşti power-plant and by everything that the city sewers disgorged into the river.

After August 1944 the history of Bucureşti is that of transition towards communism, with the city continuing to expand. Such expansion took place throughout the city, but particularly along the main access routes. New complexes of dwellings emerged and the city limit was pushed further out, reaching the orbital railway in the north and north-west.

New districts for the workers started to be built in 1957, with a surge in 1961, consisting of multi-storey blocks of flats generally located towards the city outskirts (*e.g*. Ferentari, Floreasca, Bucureştii Noi). Different institutions and enterprises built homes for their employees. Smaller residential complexes consisting of houses of one or two storeys were constructed in many areas of the city such as Băneasa. Adjacent to these complexes isolated multi-storey blocks of flats were built, especially on waste land near the grand boulevards. The dominant idea was to reduce the contrast between the downtown and peripheral districts, and to achieve this by equipping the peripheral districts with tap-water, sewage systems, electric light, street

paving, central heating and green areas, all with the goal of providing for civilised living conditions.

Important works had been undertaken to increase the water supply, both potable and for industry or public utility. Daily potable water was provided from the Dâmbovița (via water treatment works of Arcuda), from underground water and from deep wells. Industrial, public utility and irrigation water was brought in through the diversion channel from the Argeş River at Crivina, where a dam was built. During 1956-1960 a new water duct was built (1.5 m diameter) from Crivina to Arcuda. This increase in water consumption was matched by the increased size and capacity of the sewage system for household and industrial waste water. Consumption of electricity also increased. Initially, the town was supplied with electric power by two (heat producing) power stations within the city (Grozaveşti and Filaret), and subsequently augmented by at least 6 other plants outside the city (2 hydropower and 4 heat producing power stations). Much work was done to pave the streets with most streets covered in asphalt, though others were still covered in granite from Dobrogea, and the peripheral streets were surfaced in gravel or sand from the rivers.

New parks were built, particularly on the sites of former dump *e.g.* 23 August, Tineretului, Circului, *etc*. The existing parks were enlarged (Herăstrău park by 50 ha) and private parks and gardens were opened to the public. This increased green area (parks, gardens, "squares of open space, many of which were densely planted with trees") made the city healthier and more beautiful, and restored its previous state as a city covered in gardens.

During Communist regime the city expanded (Figure 1), works for the Metro (underground railway) started in 1975, the same year as flooding affected the city, though not as severely as the surrounding countryside. In 1977 intense plantation work aimed to increase the green area (2570 ha) to 20m^2/inhabitant. The green spaces surrounding the city were also improved, with the string of lakes on the Colentina River continued and enlarged, together with the new Plumbuita and Pantelimon lakes. On 4 March 1977 the city was subject to a major earthquake, measuring 7.2 on the Richter scale. This resulted in great damages, particularly in the central area and 1570 casualties. The old buildings affected by the earthquake were restored and new building were constructed on the place of the fallen ones, all this at a high speed. In order to at least partially alleviate the many problems arising from the rapid expansion of the city, multi-storey blocks of flats were built (ground floor+4, ground floor +10 and some with more than 10 floors) in each district.

In the 1980s construction of the "House of the People" began and the entire surrounding district was "urbanised". Set on an artificial hill, the House of the People is 84 m tall (12 floors) and dominates the landscape. It is the world's second construction in terms of built area (330,000 m^2) after the Pentagon. Bucureşti had become one of the most important cities in south-eastern Europe both in terms of population and area, but also in its economic and cultural life. The geographical position of the city linked central and Eastern Europe, the Baltic and Black Sea states.

In 1989 Romania experienced the most violent change of political regime in all the Communist countries of Central and Eastern Europe.

After 1990, many residents of Bucureşti left the town to build villas in the surrounding areas, and large residential projects were developed for the middle class. Construction of blocks of flats expanded both in Bucureşti and its surroundings. Villages near Bucureşti were occupied by city people building new houses *e.g*. areas such as Pipera, Corbeanca or Snagov developed in this way. However, development of such villa districts was not accompanied by the associated infrastructure, resulting in very expensive villas, sometimes without gas or water pipes, and crammed along narrow streets, with no asphalt surface, ruined by trucks carrying construction materials for further villas. A decade later, some people returned to the city centre because of the increasingly heavy traffic, the continued great delays in infrastructure development and their desire to be as close as possible to the heart and life of the city. After 2008, discussions intensified concerning the metropolitan area, which will presumably lead to a faster development of the infrastructure, and there are proposals for two more highways that will relieve traffic in the localities around Bucureşti *i.e.* a second ring road, and widening of the original ring road. Nonetheless, by 2009 the infrastructure had greatly improved when compared with 10-15 years previously.

In the lead up to the accession of Romania to the European Union on 1st January 2007, huge rises in land prices drove a second wave of expansion in the areas surrounding the city. Following the trends, the developers used so-called "empty" green areas, clearing them (of forest, farmland *etc*) and constructing districts of blocks and villas *e.g.* blocks of flats were built in Pipera, a traditional dwelling area.

Changes took place inside the city also. Some of the 'squares' within the high rise blocks of flats have been converted to car parks and play areas whilst 'low-rise' offices and shops have been built in some of the larger open spaces resulting in the clearance of the surrounding vegetation (both natural and amenity areas).

BUCUREŞTI – THE CAPITAL CITY OF ROMANIA

Rodica Gheorghe, Mariana Nica

An urban settlement is a complex ecosystem, which location was established by different causes in a certain space and which elements become ecological factors with direct physical and social implications. Frequently, a city is perceived like an eco-system within natural and anthropogenic elements are mutual conditioning, having restrictive or permission character for satisfying human needs. Ecological balance can be maintained with a territorial balance sheet within which the report natural-anthropogenic must be less damaged.

The built environment is the largest single contributor to climate deterioration – the creation and occupation of built form and the relationship between man and habitat put Cities at the forefront of the global challenge. The vulnerability of our urban environment forces us to reconsider the efficiency of urban models. Improving efficiency in the way pricey urban land is used and developed, in the transportation sector as well as in the design of commercial and residential buildings, can help moderate global climate change while contributing to a more sustainable urban future

Cities are at a crossroads – do they accommodate future growth in further urban sprawl or become denser, more concentrated territories offering more efficiency in infrastructure provision, transport usage, economic and social functions and energy consumption? High-rise development has a crucial role to play in this debate.

General data:

Bucureşti City has a surface of 228 square km (representing 0.8% from the entire surface of Romania), from which the built surface is around 70%. Bucureşti is situated on 44 24' 49'' Northern latitude and 26 05'48'' Eastern longitudes.

Bucureşti is placed in the Romanian Plain, having a maximum altitude of 96.3 m, being crossed by two rivers, called Dambovita and Colentina. The two valleys, surrounded by the rivers, divide the town in few areas by shape of plateau and terraces. The altitude up to the Black Sea level is minimum 55.66 m in the East (Glina) and maximum 94.63 m in the Western part of the city.

Geographical data:

The main water flows which are re-crossing the administrative territory of Bucureşti city and its sub-urban settlements are:

- Argeş, Sabar, Ciorogârla, Dâmboviţa, Colentina, Pasărea and Sindrilita, having part of hydro-graphic basin of Arges river;
- Cociovalištea, Vlăsia, Snagov and Ialomiţa, having part of hydro-graphic basin of Ialomita river;
- Mostiştea, among 12 km from source.

Beside these water flows, the territory benefits of a lot of lakes (more than 100), tote up about 4000 ha of water area, which is an important balance element for

the urban microclimate and for leisure too. The most representative are Snagov, Caldaruşani and Colentina lakes.

The Meadow of "Dambovita" River was modified by sewerage works. The specific features of geo-morphological elements which characterise this area, there constitute the consequence of erosion, transport and sedimentary actions of law water way of "Dambovita" River which crosses the middle line of the city (on the NW- SE direction) and the "Colentina" River, too.

Taking into account the present conditions of bio-climate of the area, which is placed between the two rivers, the soil became clayey. The second kind of soil is a sedimentary soil, it being constituted by the humus erosion, it being due to the activity of the surface water.

By the litho-logical point of view, Bucureşti area take part of the wage-class of the low plain with terraces, which consists of many successive terraces unfolded length-way of the rivers, that drainage it, an area which results only by residues accumulation during the Quaternary Period, which are represented by loess and loess-al deposition.

In the middle of Bucureşti City, the soil was created and modified by natural and man-made conditions.

Bucureşti city - Urban climate

Although the city is located in an area with temperate climate, Bucureşti is affected by the continental air flows from neighborhood. The air currents from Eastern side are responsible for the excessive variation of temperature about 70 C differences between the hottest summers and the coldest winters. The average of the annual temperature in Bucureşti city is about 10 - 11 C.

The observations and the study of the analysis data lead to the conclusion that Bucureşti city climate respected an alternation of years with low temperatures and high temperatures.

Generally, the variations of temperature between day and night are of 34 - 35 C in winter and of 20 - 30 C, in summer.

The city centre, having the biggest building agglomeration, narrow streets, large avenues and some green areas, benefits of an average of annual temperature of 11 C, a wind flow about 2 m/s, humidity of 3 - 6 % - smaller than in the other areas - and the longest green season which counts 220 days per year, without frost.

Bucureşti city enjoys of favorable conditions for a great urban agglomeration.

The total of planted surface is about of 3000 ha (representing parks, public gardens, squares, street alignments, blocks of flats, forests), which represents about 15 % of whole administrative territory. The surface per capita of inhabitants is 9.08 sq. meters.

Climatic state and urban planning – influences and conditioning in the city:

Climate is one of the basic components of natural environment with direct influence on human activities, so:

- to locate correctly an industrial objective requires analysis and discernment, because of pollution risk and to avoid the increase of existing pollution;
- The persistence of pollution in an urban area or self-purification of the atmospheric air are dependent of weather parameters and geographical one.
- the orientation and the distance between built fronts are influencing the inside lightness and sun-lit of rooms;
- the orientation of streets must permit the aeration of urban area in summer time and to keep down the creation of strong draughts in winter;
- the depth of buildings earthworks and for burying pipes/tubes must take account of thermal conditions in the area (the depth of frost, the value and the period of negative temperatures);
- The correct ad-measurement of sewerage collectors for pluvial waters depends on precipitations parameters.

The anthropogenic changes of natural environment induced by an urban settlement attract climatic changes, like:

- a different «albedo» (in general, the albedo depends on the direction and directional distribution of incoming radiation) toward the natural landscape of location; urban areas in particular have very unnatural values for albedo, because of the many human-built structures which absorb light before the light can reach the surface
- a different evaporation surface – the urbanization involves the increase of built surfaces and the decrease of free built surfaces;
- the porous soil covered with vegetation – like in rural areas – is replaced by asphalt and concrete, which are waterproof;
- the buildings of different dimensions, the green areas and streets alignments make up obstacles against winds;
- the manner of buildings location (a continuous front of buildings or discontinuous one) on the streets can induce a canyon effect for winds;
- the temperature of an urban settlement is always higher than the surrounding area (the sub-urban), because of worm sources existing in the city (inhabitants, thermal power stations, industrial areas, dwelling areas etc;
- impurities from urban atmosphere are modifying the normal chemism of the air and induce thermal differences against natural limitrophe areas, producing smog;
- the formation of a thermal island in the central areas of urban agglomerations;
- The diminution of air draughts caused of cavils created by built fronts.

Bucureşti city has three monitoring weather points: Baneasa, situated at the North limit of the territory, which registers data characteristics of general climate of the whole area, Afumati, located in a similar area than Baneasa – peripheral and Filaret, located in the central area of the city (important for studying urban micro-climate in the core of the agglomeration (local draughts, air temperature, nebulousness, solar radiation etc).

Climatic phenomena in the urban area of Bucureşti city – induced by urbanization:

Heat Island has direct effects on habitat conditions being in relation with the succession of events which produce the atmospheric pollution.

This phenomenon affects in a horizontal line a great part of the built area and in vertical line it produces like an «urban bell» being highest than blocks.

Knowledge about the existing and manifestation of the heat island is based on the relative temperature and dampness of the air in a reference area – for example: the central urban area and the peripheral one.

The shape and the dynamics of the heat island are influenced by other weather factors, too – the wind, the nebulosity and vegetation covering degree, the existence of aquatic surfaces, and the urban corridors for air circulation or buildings with various heights which induce ascendant draughts for aeration.

Actually, the heat island is the departure greater than 2C between the central urban area and the peripheral one. So, it is another microclimate, with other parameters than the natural one and more pernicious for inhabitants.

In Bucureşti, in summer, early in the morning, the departure of Heat Island is about 4 C and in winter is about 9 C. This phenomenon favors the concentrating of pollution agents and the air become more difficult to breathe, inducing discomfort for the inhabitants.

There are a lot of factors which, with the heat island, interferes in changing of weather conditions of the city – the most important being the thermal conditions and dampness too. For example, the color of buildings interferes in the different absorption of warmth.

In Bucureşti, the ruling color for buildings is grey (like cement). So, 75 – 80% of warmth from the direct solar radiation is absorbed but nevertheless the heat island exists like a consequence of the radiation balance with the contribution of human activities.

The studies elaborated between 1990-1995 for defining the heat island of Bucureşti city proved that this one affects practically the whole settlement; the thermal differences are big between the central area (-5 C in winter and 21.3 C in summer) and the peripheral area (-11 C in winter and 17 C in summer). Also, the heat island daily dynamics showed smaller values in summer, early in the morning (21-22 C) and greater values in the noon (28-29 C).

The pollution agent dispersal is directly connected with the existence of the heat island, in Bucureşti city.

For decreasing the effects of the heat island we must extend the green areas and water surfaces – so, we keep the balance between the built area and the un-built land.

In conclusion, the climate in the area of Bucureşti City**,** is characterized of big thermal differences, with successive frosts, which imposed a structure of buildings and roads resistant to bad weather. As well, the urban atmosphere is less humid and

for improving this we must develop the green areas existing nearby the lakes (Colentina). Also, Dambovita River and its´ influence area has a great potential.

The General Urban Plan of Bucureşti City (GUP) and the substantiation studies elaborated for, distinguished an unbalanced microclimatic characteristics assessment in Bucureşti (1998-2000):

The central area – were was registered the higher air temperature and were buildings has the bigger density, the green spaces have small surfaces and are few; in this area the active surface is composed of roofs, walls, pavements and were concrete, metals, bricks and asphalt prevail. So, in this area the microclimate is characterized of high temperatures in the summer time (low humidity, low air draughts velocity, smooth atmosphere);

The peripheral dwelling areas represent a transition part between the central area and the suburbs. This area is characterized of prevalent small buildings surrounded with large courtyards and green spaces, of isolated groups of industrial units. There are, also, intercalary new districts with high buildings (like Bucurestii Noi, Baneasa) which are penetrating to the central area alongside the thoroughfares. This is a complex area inducing complexity on the weather parameters. The microclimate has a turbulent specific, the air temperature is lower than in the city core but higher than outside of the city. The air pollution is lower, the air humidity is like that in the peripheral area, the fog is denser and the precipitations are more frequent than in the central area of Bucureşti city. This area with a complex microclimate illustrates the gradual decrease of urban influence and the transition to the peripheral area with specific characteristics.

- **Great surfaces covered by vegetation and lakes alongside the Colentina River** – areas with small constructions density, with higher air humidity;
- **Industrial areas:** here, the microclimate is similar to that it manifests in the central area.

2.2 Bucureşti City – major functional areas

Starting from activities assessment at whole urban level and taking to account of their type, we can obtain a general model of major functional areas existing in Bucureşti city. It is about a concentric distribution of these areas. This structure is the consequence of the strong influence induced by the territorial and the functional evolution of the city and of the fast population concentrating related to the development of economic activities in the territory. There is an alternation between the economic activities areas and dwelling areas, from the city core to the peripheral areas.

The Central area of the city: superposed on the old commercial centre of the town, extended to the Parliament and Victory Square. It concentrates specific activities of national interest, from which derives the attributes of capital city. The types of services, especially financing and banking, commercial, cultural activities and political–administrative are very strong elements of daily attraction for the inhabitants of the whole city, for inhabitants arrived from the entire country or for foreigners. This superposing of activities and this type of concentrating activities and

people make the area being, sometimes suffocating. There is a disparity between the central area of Bucureşti city and the peripheral area, from the point of view of the assessment of services activity.

The internal habitant area: is the second concentric area in which the buildings have a reduced number of floors, alternating with individual houses (built on plots). This area is better equipped with commercial and cultural endowments. Also, we must say that this area was damaged by the great urban operations during the communist period (especially 1980 – 1989).

The internal industrial area: was developed on the outskirts of the interwar Bucureşti. The distribution of this area is alongside the main inner ring. For now, this area abides important functional changes. First, because the industrial units located here were pollution sources for urban environment and other, because the functional conversion becomes more attractive and profitable.

The great habitant area – is make up of the new districts built in the communist period, composed of big blocks ensembles with endowments for habitation (for health, education and leisure – parks). These one involve about 60% of inhabitants and have a lot of problems. First, the circulation connections with the industrial areas are not enough developed for a fluent traffic.

The complex peripheral area – dwelling and industrial one; here the field has an agricultural land use, too and there are leisure endowments (forests, lakes, sport grounds etc). A considerable area of agricultural land still exists within city limits. In the north of the city there is a large forest, Baneasa-Tunari. Along the urban perimeter, there is a series of lakes bordered by green areas.

Now, after the communist period, we can see that the urban dynamics is changing gradual, depending of economic activities modification – the industrial activities were restructured and the tertiary sector (services) development is in progress. This new structure of economic activities will change gradual the urban structure of our city. It is a matter of time.

Main pollution sources in the administrative territory of Bucureşti city - urban planning point of view

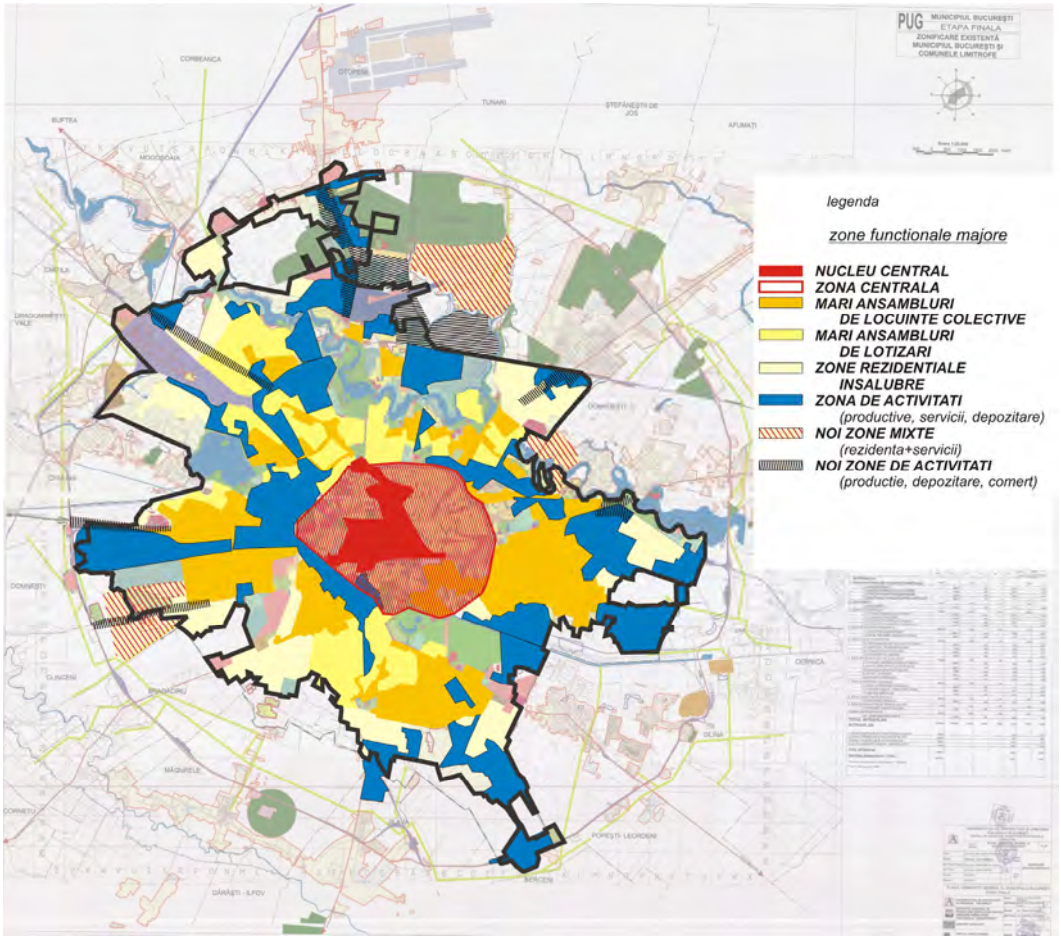
From our point of view, as urban planners, we are fully aware of the importance that the environment quality in urban areas are determined by the manner of built and of circulating organization, with a great influence on life quality of the residents.

In Bucureşti city, there are a lot of pollution sources for the natural environmental factors like water, soil, atmospheric air and vegetation. Besides we mention the phonic pollution from stationary or movable sources. All these are producing discomfort for inhabitants and could be causes for illnesses too.

The main cause of air pollution in Bucureşti, for particles is represented at present by the increasing traffic in the city.

In the past, there were several industrial sites in the outskirts of Bucureşti that were heavily polluting. Yet, in the past ten years, as production declined and some of

the industrial areas shut down, the main source of pollution became traffic and the combustion plants for central heating, as well as individual heating systems



Bucureşti – major functional areas

In Bucureşti, the process of agglomeration appeared especially in the years 1990, due to the fast growth of the motorization degree and also because of the low capacity of the thoroughfares that cannot ensure anymore the fluency and the safety of the traffic. The existence of the agglomerations points that the traffic tent to be very close to the road network capacity limit which leads in the end to the impossibility of movement.

So, we can say that in Bucureşti, the urban transport induces modifications of the atmospheric air quality, as well as of the waters and soil and brings phonic pollution.

All these are determined by several main causes:

- the structure/systematization of the traffics at the city level, the built street network being mainly of the annular type. The congestion points are especially focused on the direction N – S of the Central Area, where the transit traffic develops on the same arteries with the local traffic, because the distance between the main arteries is too long. We also include here the existence of numerous

conflict crossroads of some important traffic arteries, the deficient inter-modality between the various types of public transport and the acute lack of arranged spaces for the vehicles parking.

- the transport activities that develop in the municipal territory (public transport, the traffic of all the types of vehicles).
- the physical state of the passable surfaces. The damaged asphalt coats are permanent sources of dust.

Areas of interest to the public have a large impact on the mobility of the population, and therefore on public transport needs.

The following factors influence the balance of public transport and also the whole transportation activities in Bucureşti City:

- The concentration of activities regarding luxury trade, education/culture, health and administrative services, as well as the historical structures in the city centre;
- The transformation of some old buildings located in the city centre (ex-residential areas) in commercial areas;
- The suspension of construction works on a considerable number of blocks of flats in the city centre;
- The change of the relationship between home and the workplace and increasing distances have resulted in the stagnation of industrial activity (prior to 1990 there was a program in which high blocks of flats were built for workers near industrial platforms);
- The existence of small or medium-sized factories within the perimeter of residential/commercial areas;
- The construction of medium- or high-quality living spaces in suburban areas;
- The recent construction of large commercial centers in suburban areas aimed at affluent car owners;
- The presence of wholesale storehouses near the border of the urban area;
- The agricultural surfaces and vast forest areas in the suburban area to be built up.

Mal-functions of the circulations network – which generate pollution

Bucureşti's road network of is structured mainly on two concentric (central and peripheral traffic rings). It has a radial and circular distribution and a total length of approximately 1,900 km. The distance between the main streets in the central area (the inner traffic ring) is roughly 1 km on the east-west axis and 2-3 km on the north-south axis. Traffic volume on the boulevard network (nine boulevards converge on the inner traffic ring and city centre — Piata Unirii) and can reach 50,000 vehicles per day in both directions. At the same time, traffic congestion has caused more and more problems, reflecting the accelerated rhythm of individual traffic.

The congestion points are located in the main intersections along the inner traffic ring, in the central area and on the roadway along the north-south axis. Congestion has a negative impact on travel times, air pollution and parking problems. The city does not have enough parking facilities in the central area, which leads to the occurrence of "parasite" parking spaces on the roadway. The city's traffic management is currently done by using a traffic light system that covers 240

intersections (it has a synchronize flows only on the arterial roads) and the one-way traffic system implemented in the central area.

Characteristics of the transport network - Bucureşti's transport network features:

- an incomplete radial-circular road network (nine radial arteries, two semi-circular arteries and one outer circular artery at the edge of the urban area);
- an inter-regional/international railway network, with a terminal point at The Northern Rail way Station) on the inner traffic ring, and on the outer traffic ring a railway line for freight transport for the factories in these areas;
- an underground railway network that links the city centre to the industrial/residential areas along every radial direction, and a circular route below the inner traffic ring (used as a link between local points of interest: Northern Rail Way Station and Obor);
- A surface networks for other transport modes such as trams, trolleybuses and buses, which are poorly integrated, both with each other and with the underground.

Urban mobility and quality of environment in the Bucureşti area

Although a city is, in many ways, a superior arrangement of habitation, it is a dynamic system that depends heavily on other environmental systems and sub-systems. A study of the relations between the physical-geographic framework and guidelines for physical development of Bucureşti's urban area must take into account the impact of any extension on the systemic functions of the city. The structure of transport infrastructure plays an important role in urban development; satisfying mobility need in turn, impacts the environment.

Urban mobility is bringing significant changes to the Bucureşti area. It is necessary to draw up some mobility scenarios adjusted to the "personality" of urban structure. In this context, transport is an important factor for development, and accessibility to functional areas of the city has to be a priority of urban-territory planning and transport network planning. Thus, the links are clearly defined among urban-, transport- and environmental strategies.

Urban transport strategy is related to principles of urban development. It takes both the satisfaction of mobility needs and environmental impact into account. From this point of view, improving the quality of environmental parameters in Bucureşti refers primarily to improving air quality and decreasing noise and vibration levels, with priority given to central areas and residential districts.

The General Urban Plan and the Master Plan of Transports - JICA Study

The evaluation of environmental conditions in the urban area of Bucureşti was included in the Transport Master Plan carried out by JICA – Japan International Cooperation Agency (1998- - 2000).

The conclusions of the study about quality of environment factors were the following:

- The transport sector plays an essential role in the quality of the urban environment and the environment in general. Transport contributes heavily to pollution levels, and different transport means are the main source of nitrogen dioxide (NO2) and carbon monoxide (CO), which are the principal pollutant compounds in the urban environment. The harmful effect of pollution on health is more powerful in the urban environment, where most of the population lives. On the other hand, transport plays a key role in economic activities and increasing travel convenience.
- The considerable impact on the environment by the road transport sector is due to emissions of nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOCs), lead and other particulate matters
- (PM). Those substances affect not only ambient air quality directly, but also some substances causing adverse pollution, such as photochemical smog.
- The emission volume of each substance is related to vehicle speed, where the emission volume is greater at low speeds.
- In a comparison between Bucureşti and other European cities, Bucureşti is less polluted from NOx, sulphur dioxide (SO2) and carbon dioxide (CO2), but more polluted with particulates, lead and VOCs. Particulate matter and lead concentrations sometimes exceed the standard values. These substances have larger concentrations in the city centre, where traffic volume and congestion are greater.

The Transportation Master Plan of Bucureşti, approved by The City Council in 2000 and up-date in 2008, promotes in its development strategy the following objectives:

- The creation of a transport system and of a transit oriented to the city in order to revitalize the capital's surroundings;
- The determination of an urban structure that shall reduce at minimum the traffic congestion and the environment prejudice;
- The conservation of the green belt area that surrounds the city by keeping a compact structure of the city;
- The protection of the historical perimeter from the centre of the city in order to become a commercial attraction and resting point;
- To develop the institutional systems so that there shall result an efficient use of the lands;
- To establish a systematized and formed on the hierarchical system network of public transport;
- To promote the cross modules use of the multiple means of transport in order to assure a high mobility and to control the traffic congestion;
- To encourage the use of the arteries by the types of beneficiaries;
- To establish and to analyze the performance of the street network by building the annular arteries, divisions on levels in the important crossroads and generally the completion of the roads network;
- The achievement of buildings and endowments related to the transport of goods like: storehouses and terminal for trucks along the city's limits;

- To adopt management policies of the parking spaces in order to allow the control of the vehicles that enter the city;
- To support the institutions that's invest in its infrastructure and to encourage the citizens' participation at the taken decisions relating to the different strategies.

The General Urban Plan regulates and guides city development and land use policies, including policies regarding the extension of the public transport network in Bucureşti. At present, the road network in the study area (Bucureşti and its metropolitan area) includes the streets that belong to the peripheral inner traffic ring (administered by Bucureşti Municipality) and the road network that links the towns in the metropolitan area (administered by the Ministry of Transport).

Travel needs depend directly on the intensity of economic and social life and increases in living standards, due in part to the tendency to separate residential areas from industrial areas. More than that, transport demand around large cities reflects their "areas of economic influence." From this perspective the importance of public transport is due to its advantages over private transport: bigger capacity at the same degree of carriage occupancy, with lower energy consumption and pollution (per passenger-kilometer).

For now, the complex JICA study is in a process to be makes up-to-date and the strategy too.

The current urban development plans take into consideration the physical-geographical conditions of the area and impose certain directions, both for the transport network and dispersion of the attraction poles. At present, Law No. 50 of 1991 (concerning the license of construction and some measures for house building) is the basic law that prescribes procedure and norms for building and land use.

The Territory Arrangement Plan should be prepared from the national level down to the communal level.

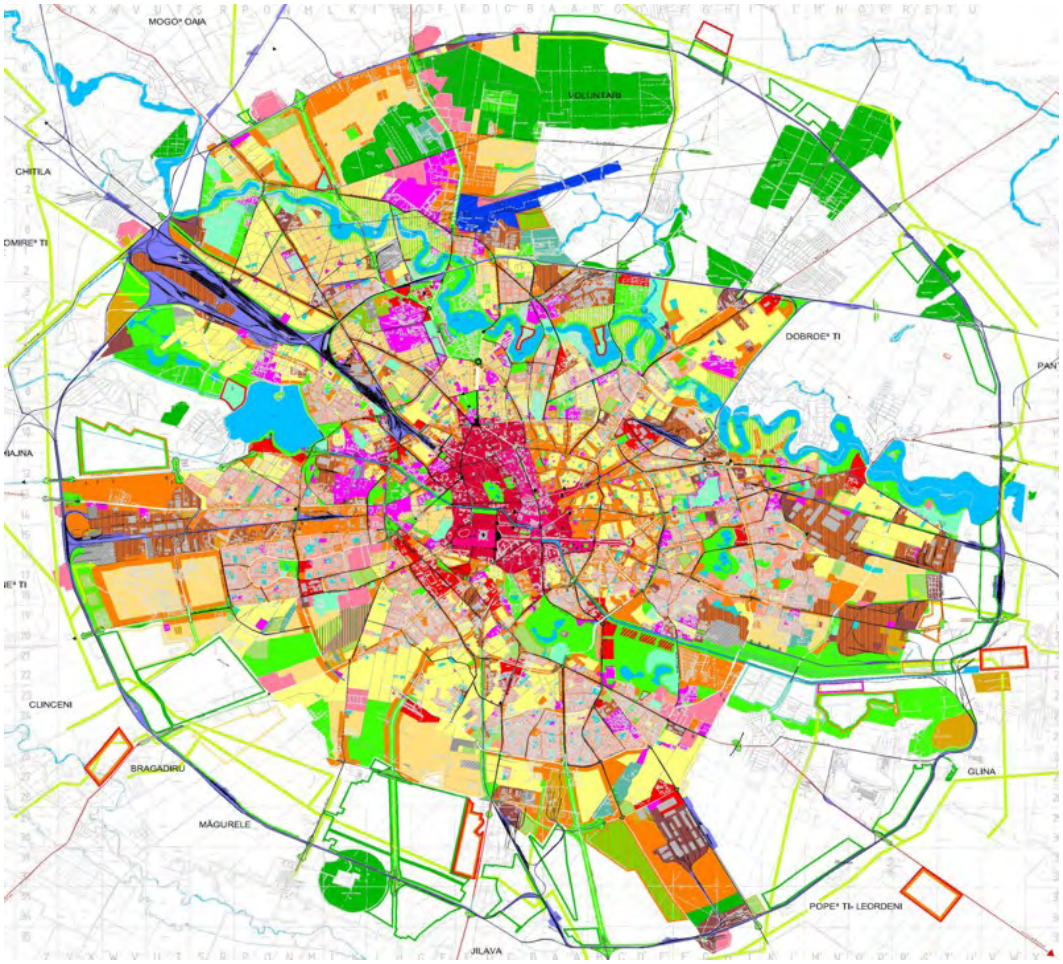
The General Urban Plan (GUP) runs from the municipal level to the "village level" and for resort areas. The Zonal Urban Plan (PUZ) is prepared for the central part of each level of administration and for zones of special use or protection. The Detailed Urban Plan is a set of documents required for every construction project in the urban area and classified into two categories: national and local. Bucureşti Municipality is now preparing its Regional Territory Arrangement Plan (PATZ) that covers the Bucureşti metropolitan area (BMA), including peripheral communities, as well as the PUG within the municipality.

The development strategy of the municipal and metropolitan territory of Bucureşti elaborate for the 2025 year horizon, is orientate thought the stimulation of the economic, social, and spatial development, to ensure an offer more diversification for attraction of the investments from public and private initiative, with the simultaneous respect for the national, local community and each habitant interests.

The development strategy vision that was proposed: the Capital of Romania, Bucureşti will become a European metropolis having a specific regional, continental and intercontinental roll.

For the objective, what will place the Capital in the 2025 at the same actual level with the others European metropolis, General Council of Bucureşti approved thought the Decision no 148 from 24.06.1999) the next strategic objectives:

- To accentuate the identity of Bucureşti Municipal in harmony with the goal to became an European metropolis;
- To sustain vitality and attractively of Bucureşti Municipal fit to the role as Romania's Capital.
- The development of the Capital as an urban agglomeration having an attractive and simulative role at the regional end metropolitan level
- To increase the quality life of the inhabitants
- To protect and to valorize the natural, architectural and urbanity potential.



The General Urban Plan of Bucureşti City (GUP)

The present urban dynamics of Bucureşti city

Nowadays, Bucureşti city is sustaining a major pressure for adaptation both from the external medium - the pronounced international tendencies of development (globalization, urbanization, embracement of the sustainable development priciples, the integration into the EU) and from the internal medium, such the tranzition from an urban development completely political handled, grounded on unilateral decisions (like a characteristic of the period before the ´90th) to a new development approach based on urban analysys and feed-back.

The nowadays dynamics of the major functional areas in Bucureşti city

The continuous evolution of the functional areas in the city is viewable develop by the permanent „territorial move" of its' major functional areas

So that, the Central Area, in urban sprawl, is expanding constantly at North, localizing some urban functions alongside of the major transportation network. For example, the habitation area from the Northern side of the city, starting from the Victoria Square, became a target area for financial – banking functions and diplomatic head-quarters, urban functions which will be located, mostly, in the area of the Parliament Palace (the city core). These urban functions are attracted by the proximity of the two services nodes – Victoria's Square and Press House Square, that are an important transportation nodes at whole city level and, especially, they are functional nodes on the transit axis at the international airport Henry Coanda.

The internal mixed area is moving its' habitant function to the exterior, trending to a preponderant services function, needed by the central area status. It becomes a kind of extension of the central area, having, in the same time, a habitant function. This area is hard pressed by the activities located in the peripheral area of the city, which have the tendency to come into the central part, so nearly as possible, especially with the marketplaces (for example, the hyper-markets, which are attracting important circulation flows). Structurally speaking, this area is more stable, its configuration being more flexible and adaptable to the new needs of the city. For now, the services function isn't localized only alongside the main transportation roads, because of the massively migration of the habitant function; so, the services penetrated in the habitant areas, producing a mixing process of these functions.

The peripheral area is suffering major structural and functional changes; practically, this area is in a continuous process of configuration. But this process in progress is quit indistinct, generating malfunctions at the city level of approach.

The area is functional slaty; alongside the peripheral road ring are localized the productive and storage activities, alongside the main road penetration (especially on the Northern, Western and Eastern side) were develop commercial/sale activities and in the free land territories, former agricultural lands, it begins to appear new habitation areas, with individual and collective dwellings with a low height, ensemble.

The main structural problem of this area consists in its non-correlate urban development and incongruous with the General Urban Plan regulations.

The dynamics of the major habitant area (with collective ensembles of blocks of flats) is taking place only inside, only at social level, by changing population and according the internal services to the needs of the inhabitants.

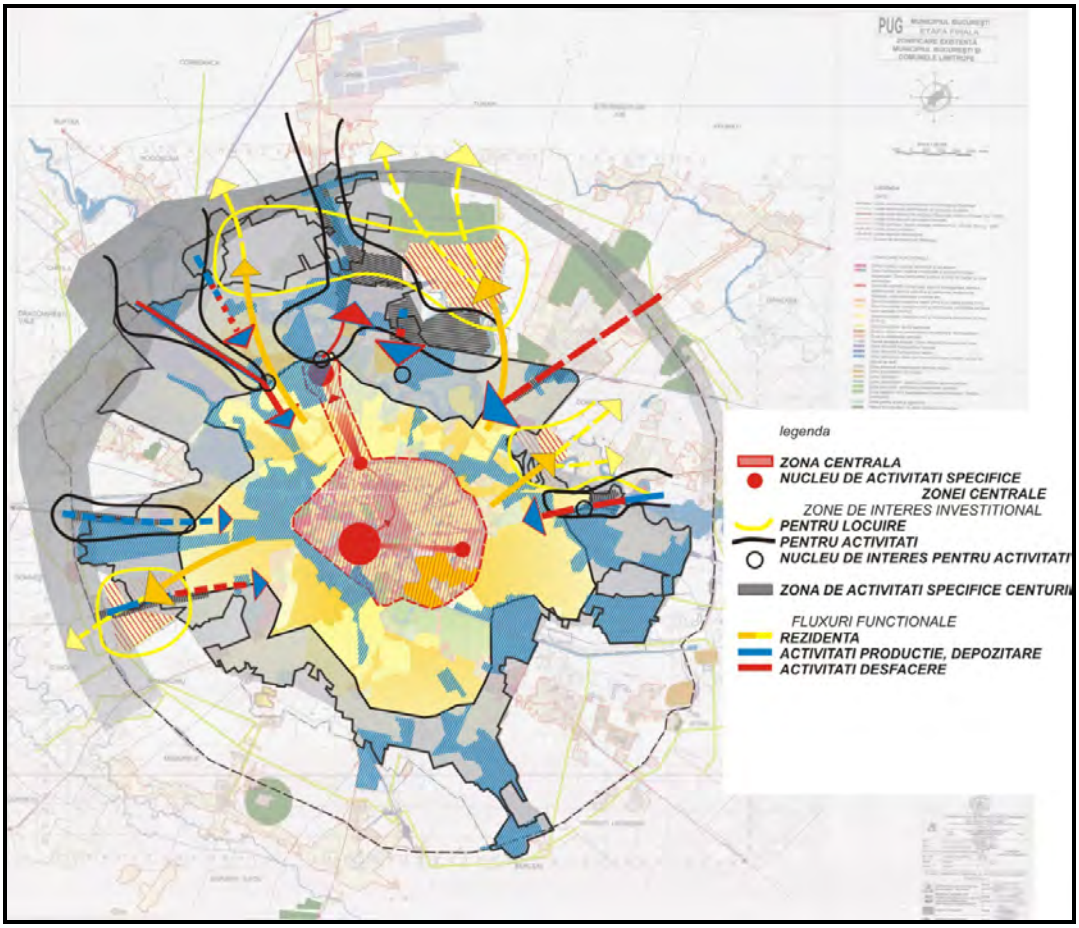
Urban Planning Queries:

a. The height regime (conditions) of the built areas in Bucureşti City:

For providing a thematic map of the height regime of the built areas we estimate that we need to obtain information about buildings, structured like that:

- Height from the ground level to 5 m;
- Height from 5 m – 15 m;

- Height from 15 m to 20 m;
- Height from 20 m to 25 m;
- Height from 25 m to 30 m;
- Height from 30 m to 50 m;
- Height from 50 m to 75 m.



București nowadays urban dynamics

Motivation:

Air circulation in a city is controlled by natural and anthropogenic factors, for example, the air temperature, the roughness of the surface and the presence of various barriers (hills, forests, high buildings).

The presence of tall densely packed buildings in cities changes the prevailing wind speed and direction. They also allow local air circulation patterns, for example the urban breeze, to be set up. Wind may improve the air quality in a city by clearing the air of pollutants but it also may cause too much heat to be lost from the buildings

Buildings act as barriers to the wind and, in the centre of a city, average wind speeds are about 20% lower than in the suburbs.

The height and the geometry of the buildings are influencing the air circulation directions and, implicitly, the pollution dispersion. When the wind hits a high building, the air stream divides. A part of it moves upwards and the rest goes around the building. This causes an increase in the wind speed by up to 30% at the corners of the building.

b. The section (profile) and shape of streets in Bucureşti City:

Motivation of the choice:

The shape and orientation of the streets - As streets usually cover more than a quarter of the urban area, canyon street morphology plays an important role in creating the urban climate. It directly influences the air temperature, moisture and wind-flow within the streets as well as the urban surrounding area.

The section (profile) of the streets – In Bucureşti, the oldest part of the city, especially inside the inner traffic ring, is characterised by tight streets, which generates traffic congestions and, implicitly, air and phonic pollution. The main road network of the city of Bucureşti has a length about 453 km and keeps the traditional configuration (radiate like a ring system). This form of the main road system was required to Bucureşti by economic grounds, for keeping the most part of the city dowry, which suffered a historical growth like concentric and progressive waves (from inner area to suburb areas).

Traffic flows and congestion areas – as pollution sources

Mal-functions of the circulations network – which generate pollution - Bucureşti's road network of is structured mainly on two concentric (central and peripheral traffic rings). It has a radial and circular distribution and a total length of approximately 1,900 km. The distance between the main streets in the central area (the inner traffic ring) is roughly 1 km on the east-west axis and 2-3 km on the north-south axis.

The congestion points are located in the main intersections along the inner traffic ring, in the central area and on the roadway along the north-south axis. Congestion has a negative impact on travel times, air pollution and parking problems.

c. Green spaces – important planted areas – with public access (parks, squares) or with special destination (ex: cemeteries).

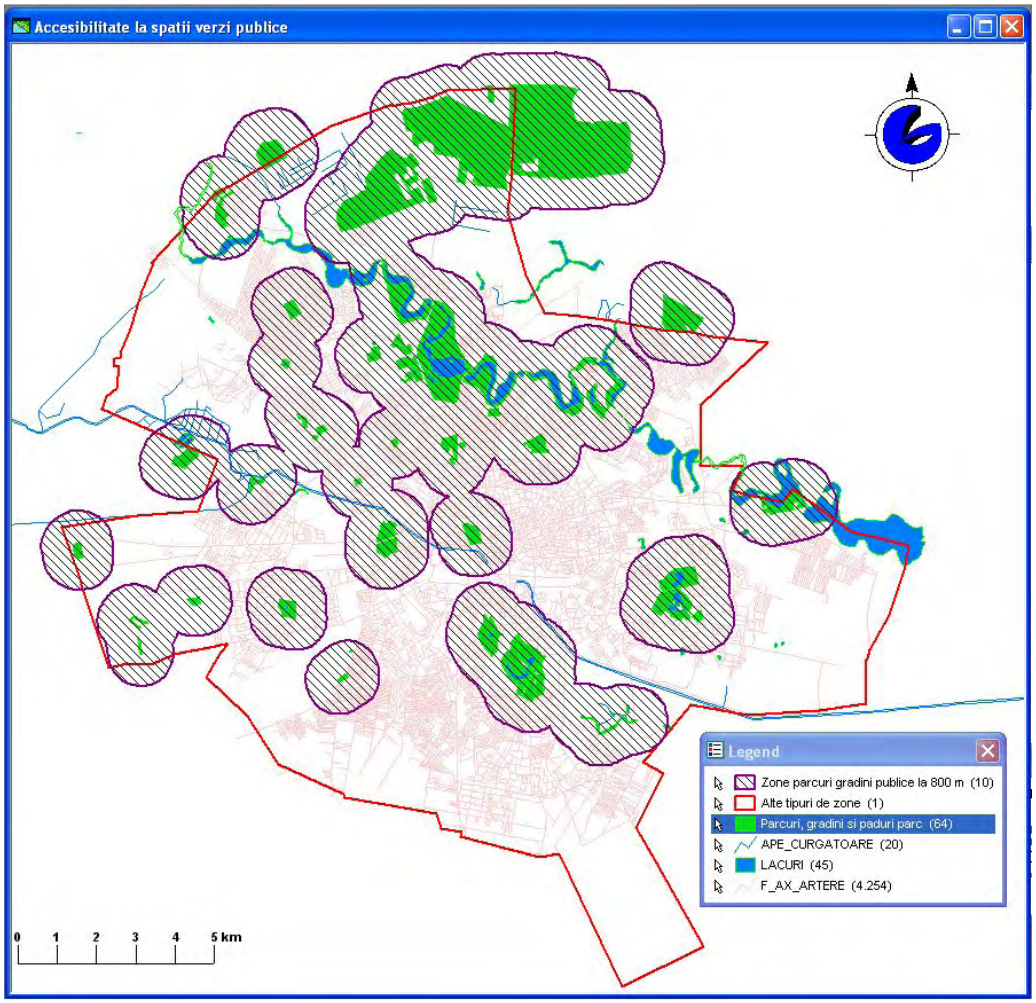
Green, open spaces in urban areas have significant potential to improve the quality of life of city and town dwellers, the urban environment and urban sustainability. The need for innovative strategies for the design and management of green spaces within cities, taking account of the complex interactions between nature, economy and social systems in urban environments

More specifically, the microclimatic effect of trees is obtained through several processes:

- Reduction of solar heat gains on windows, walls, and roofs through shading;
- Reduction of the building long wave exchange with the sky as building surface temperatures are lowered through shading;
- Reduction of the conductive and convective heat gain by lowering dry-bulb temperatures through evapo-transpiration during summer;

- Increase of latent cooling by added moisture to the air through evapo-transpiration.

Also, trees are reducing the air pollution level by retain of dust particles on their leafs.



Accessibility to public green spaces (public gardens and parks
Service radium 800 m (12 min. of walking)

d. Habitant areas – in relation with the habitation density

We intend to survey the traditional dwelling areas – in the inner part of the city, which has its own particularities and in the newer dwelling areas with collective ensembles of blocks. Here, we area speaking about two different manner of building, with particular morphologies and, comparatively, with different problems. We will analyze this type of functional area, because it is about a lot of people which are living here, being exposed to the potential air pollution.

So, as much as an urban area is much denser built, so much people is living inside and we can suppose that they will be exposed.

e. Another functional areas of the city – for example, mixed areas (services)

These urban areas may be potential sources of pollution because of attractable circulation flows. Also, these areas may induce malfunctions from the point of view of circulations at local level.

Our survey and analysis, based on the data provided by NAM and EPAB, have two levels of approach – multiple thematic analyses (on criteria of selection like those foregoing) and an integrated analysis, finalised with scenarios of development, recommendations for urban development for Bucureşti City. We will associate our thematic analysis with demographic data (as results from National Census 2002).

The pilot area was, at first, the Central Area of Bucureşti City – the Core, as the Historical Centre, because this urban area is, on the one side the most dense built area of the city (with tight streets and high urban indicators, like the land use coefficient) and on the other side here we find a varied functional interference (for example: services, dwelling), which involve a various groups of population and, in the same time, circulation and pedestrian flows. At the end of the Project, the application area will be the whole administrative territory of the city.

Types of interventions from the urbanistic point of view, according to the Romanian laws, which are included among UMPCB competences:

1. Long term interventions – urban regulations at the city level

The General Urban Plan (GUP) is orientated to the stimulation of the economic, social and spatial growth of the City and its Metropolitan Territory, in the actual international context, according to the principles of sustainable development;

The essential contents of GUP are regulations and restrictions on which basis urban development certificates and building permits are issued inside the urban areas and settlements concerned. The rules and spatial regulations of the GUP took into consideration the potential of the existing resources - economic, demographic, natural as well as cultural once - maximizing the chances of the City to integrate itself into the network of European successful capital cities. The GUP contains the strategy, priorities, regulations and restrictions of urban planning applied to land use and building use within the urban areas and settlements, concerning the following:

- Demarcation of urbanization promotion areas
- Division of land-use areas
- Size, structure and distribution of population and labor force
- Economic potential and distribution of activities
- Establishment of circulation system
- Establishment of use zoning with control indicators such as building height, building coverage, floor area ratio and building prohibitions
- Locations of public land-use for public facilities
- Designation of historical areas and sites
- Designation of construction restricted areas
- Designation of rehabilitation areas

– Development of urban utility network system
– Rehabilitation, protection and conservation of environment

For now, the GUP 2000 – 2010 must be up-date, because the dynamic development of the city made many changes in its' functional structure. The Law 350/2001 regarding the urbanism and the territorial planning established that this type of strategic regulation must be up-date after ten years, too.

Strategic guidelines of territorial spatial development of Bucureşti City:

At the city level:

Urban development – decentralization

From the viewpoint of functional structure of the city (zoning), we are taking into consideration the following concepts: The decentralization concept has proved to be ineffective as functions are related to each other and the decentralization can result in unforeseen developments. For that reason, functions should always be regarded in context with the surrounding functions.

To induce an urban balance development – delineation of urban poles for development in privileged areas or in coherent existing urban zones with good accessibility. Segregation and decentralization of the individual commercial, residential and industrial areas in more centres in order to release the city core of the actual traffic flows. Disadvantage of this zoning concept is the fact that the clustered areas can result other congested areas

No segregation - integration of functions, mixed functions – especially in habitant areas, which needs specific endowments, in order to minimize traffic flows in/out the city center. Of course, this functional amalgamation will take into consideration the compatibility between urban functions in the same area and the needs of the inhabitants.

From the viewpoint of circulations at city level, we are taking into account measures regarding the support of using public transportation as an alternative for transport by individual car, like self lanes for tramways or self roadways for other public transport kind.

Taking into account that the interaction of traffic and persons resulted in dangerous situations, especially in combination with heavy traffic and the heavy trucks can cause enormous congestion in narrow zones as they can block the way for the remaining traffic during loading/unloading, in Bucureşti, local regulations introduced truck-free inner city (from the city core to the main traffic ring). This measure is applied to improve the safety of pedestrians in narrow areas and improve the quality of life in the inner city. To supply the several shops, service roads are available, which can only be accessed during certain off-peak hours or time frames.

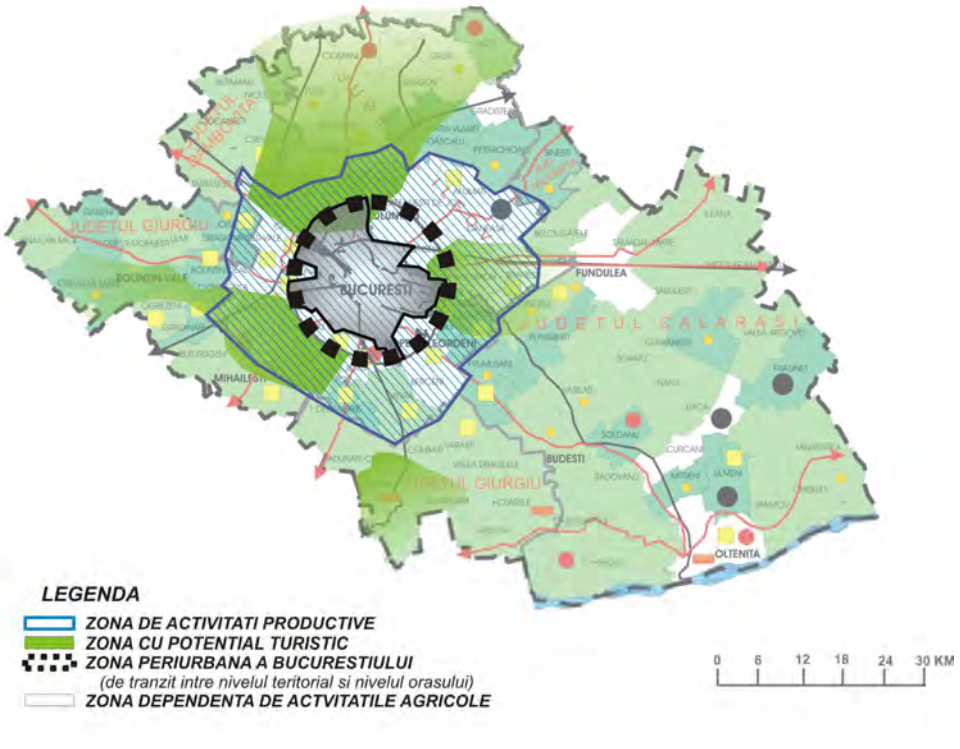
Also, it must be solved the public parking problem, which, in the last five years, became imperative.

At the territorial level:

According to all studies elaborated for Bucureşti city and its' supporting territory and European spatial development tendencies, our capital city must become

a real Urban Agglomeration. Actually, Bucureşti is functioning like an Urban Agglomeration but there are many malfunctions and there is not a legal frame for this type of administrative organization.

And, of course, it must be institutionalized the metropolitan area of Bucureşti city. Starting from the principle that, regardless of our wishes and priorities, the development of Bucureşti are having the already existing infrastructure problems, whose solution requires time, blocked traffic and more money, we can draw the simple conclusion that Bucureşti needs a controlled development and a perfect correlation between long term urban planning, infrastructure and the constructions to be achieved in each area. Therefore, we believe that in the near future the creation of a metropolitan area become a necessity, and the authorities must develop a coherent strategy to expand infrastructure and to develop public utilities.



The Metropolitan Area of Bucureşti city – territorial relations
(Source: The Metropolitan Area of Bucureşti City study, elaborated for the Bucureşti City Hall)

2. Long term interventions – urban regulations at the local level – for urban areas

The GUP directory regulations, according to our laws, can be modified at the urban areas levels with another type of urban regulation, the Zone Urban Plan (ZUP), which can change the functional land-use and urban indicators (the occupation land percent, POT, the land-use coefficient, CUT, the height regime of building).

In the last five years, Bucureşti city is going over a complex and dynamical development process. So that, the functional areas being established by the GUP 2000-2010 were modified by a lot of local urban plans, which changed the land-use coefficient and the height regime of building, especially.

Such a density of buildings, which involves population and vehicles affluxes, affects the quality of the environment (the air, especially, will be polluted). When an urban area with a low level of height modifies the height regime and so, will be permitted to build higher, that fact determines the increasing of population density in the area. Not only this fact, but also the built area reported to the whole plot will increase. So, the not built area of the plot will decrease and we will not have more green areas – we will have only concrete and asphalt. In this way, not only the soil is affected, but the quality of air and the residences' health too.

The Zone Urban Plans are realized for detailing the regulations of the GUP or for modifying these. At the beginning, this practice of making ZUP for different urban areas has a real support, because the GUP regulations aren't enough detailed but, in time, this process comes to change the GUP character and can spoil the city balance. Modifying over and over isn't in the city benefit. It's true that, the Law 350/2001 revised in 2006, established that a ZUP regulation on an urban area can be modified only after a year, but it is not enough.

This practice of derogation urbanism must be stopped for now and our professional team must start to evaluate all the major changes made in the functional structure of the city.

In 2010, it is the legal time for up-dating the GUP and we hope that the system created in this project will become a useful tool for analysis and conclusions.

3. Long term interventions – specific case – transport network/circulations

Malfunctions of the transport network in Bucureşti city:

- Imperfect radial/ring road network (nine radial roads, two half ring roads and an outer ring road on the outskirts of the urban area)
- Interregional/international railroad terminal of the North Railway Station on the inner ring road and an outer ring railroad transporting freight to and from factories along it;
- Metro, as the most important public transport system, connecting the city center with industrial/residential areas in each direction (radial), and a ring line under the inner ring road connecting district centers such as the North Railway Station and Obor;
- Route networks of other public transport modes, such as tram, trolley bus and bus, not forming simple patterns and insufficient interconnection among public transport modes including metro.

The road network in Bucureşti is basically formed by a radial and ring road pattern. The major roads are the nine radial roads centering on the University Square and the two half ring roads located about 3 and 5 km respectively from the center. These major roads are mainly more than 6 lanes with a width of 21 m or greater. In

addition, an outer ring road with 2 lanes is located at the outskirts of the urban area of Bucureşti City, and it is mainly used for freight trucks at present.

The main road network of the city of Bucureşti has a length about 453 km and keeps the traditional configuration (radiate like a ring system). This form of the main road system was required to Bucureşti by economic grounds, for keeping the most part of the city dowry, which suffered a historical growth like concentric and progressive waves (from inner area to suburb areas).

The development concept of the street network

The type of annular texture is characteristic to the cities with slow development that initially started from a crossroads and presents some advantages:

- is not rigid and easily adapts to the local conditions;
- allows a good accessibility to the centre of the city;
- Relieves direct connections between the major peripheral functions.

But, the annular texture frequently leads to the congestion of the centre, creating difficulties in the traffic. The mixed system is a combination of the annular system with the rectangular system and leads to evident improvements. The texture of the city of Bucureşti is of rectangular type in its central area (in the limits of the central quadrangle), in the great residential districts, and at the macro level there is an annular texture.

Road Conditions and Intervals:

The total road length in the city of Bucureşti is approximately 1,900 km, of which 160 km is trunk roads according to the Municipality. The total road area is about 21 square km, about 80% of which is paved with either asphalt, concrete or stone. Except for the major arterials, the road surface is generally not in a satisfactory condition due to insufficient maintenance work. The interval or spacing of the trunk roads in the central area (inside the inner ring) is about 1 km for the E-W direction, and 2 to 3 km for the N-S direction. This indicates that the density of trunk roads in the N-S direction is very low compared to the E-W direction. As for the surrounding area, the interval becomes greater, about 3 to 4km for both directions.

The interval of local streets generally ranges from 70m to 300m depending on the district and direction.

Design Standard:

- Urban roads are classified into 4 categories according to the national standard (STAS 10144/1-80).
- Category I is the most important arterial road with 6 lanes or more.
- Category II is a secondary major road with 4 lanes.
- Categories III and IV are collectors and minor service roads with one or two lanes.

Road Length and Area:

The total road length in the city of Bucureşti is about 1,940 km (1998 – JICA Study – the Master Plan of Transport for Bucureşti City).

According to the UMPCB competences, the long term interventions which can be made by us are regarding the systematisation of circulations in the whole city – the functional use of each road, avenue or street and, in relation with this aspect, the breadth of these. Our institution, by its' own designing department for urban circulations, is making proposal for enlarging the sections of roads/streets, where it is necessary and, further, even proposals for new thoroughfares too.

Types of analysis which we are making for providing conclusions regarding the future urban development of Bucureşti city, taking into account the AIR AWARE System

The goal of our professional team in this research is to provide urban planning solutions for Bucureşti city, in order to mitigate the air pollution.

So, the basic principles for us are: the urban development must be accomplished in accord with the support capacity of the urban environment (natural and built, in the same time), the balance between the economical and social development, on one side, and the environmental protection and amelioration, on the other side. And, last but not least, the solutions which will be adopted must solve the problem, starting from the cause and no treating only the effects.

In our research, we are taking into consideration some information provided by the AIR AWARE System, such as:

- Forecasting data (48 hours) for the urban temperature at city level and for different urban areas;
- Information about air pollution resulted from traffic – graphic representation for before settled sits, for various hourly spells and weekly variation;
- Information about air pollution as a result of a significant number of emission sources, especially thermal power stations;
- Information about the quality of the atmospherically air, provided by the permanent monitoring stations, which belong to the Local Environmental Agency of Bucureşti City, the local authority which has the legal mission to oversee the status of environmental parameters in the administrative territory of Bucureşti.;
- Pollution forecasts for each selected pollutant, at the city level – having the possibility to observe the urban areas possibly affected;
- Forecasts for trajectories of pollutants, correlated with the direction of the main winds – providing the urban areas possibly exposed.

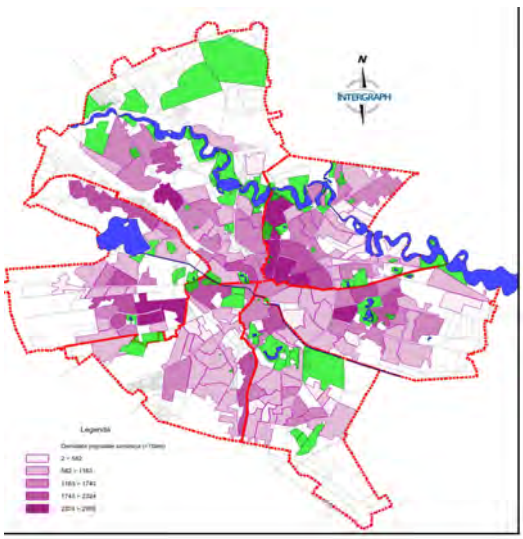
How we use all these information - Analysis levels:

Operationally:

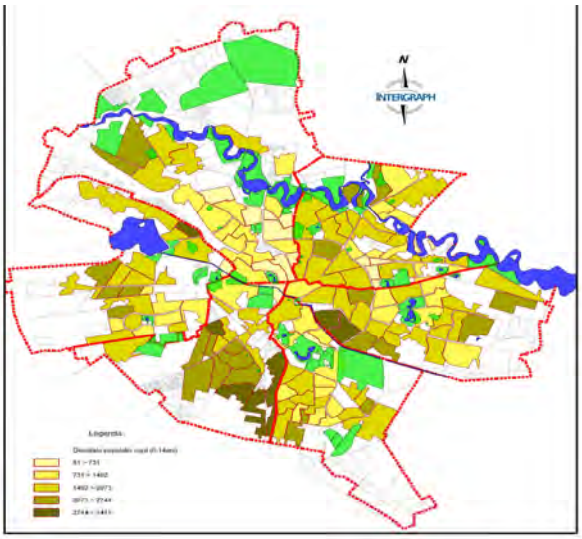
- Daily pursuance of the meteorological and pollution forecasts for the administrative territory of Bucureşti as result of the pattern making in the Air Aware System – emphasizing the urban areas possibly being affected (especially the big collective dwelling areas);
- Daily pursuance of the trajectories of the pollutants , emphasizing the urban areas possibly being affected;

- Making selection among urban areas with problems from which the system provides complete information regarding the air pollution – making various analysis regarding the potential of exposure;
- Monthly, the conclusions of these analyses will be the subject of some thematic maps, represented in a GIS System.

In order to provide urban planning scenarios for the improvement of air quality in Bucureşti we are making sociological analysis at whole city level and for selected urban areas. They are represented in thematic maps like the next below.



Density and assessement – mature population (70 years and more) representation on census districts, 2002



Density and assessement – children 0-14 age, representation on census districts, 2002

Strategically conclusions:

Starting for this type of analysis, we will provide urban planning scenarios in order to improve the quality of life in Bucureşti city, especially for air pollution mitigation.

Among the results of our work we are mentioning: the map of urban areas with high traffic congestions (exposed to the air and phonic pollution), the map of urban areas the most exposed to air pollutants, urban areas with high habitant density, the map of still existing green areas and so on.

We hope that the conclusions resulted from our work with the Air-Aware System will be very useful in the process of up-dating the General Urban Plan of Bucureşti City, 2010.

All these, because our main goal is that our Capital City must become more productive, more competitive, more innovative. At the same time it must be sustainable.

To make our city more liveable and to improve the quality of life and sense of community for all who live inside. For this to happen we must have a long term vision for our city. Meeting the climate change challenge requires a whole of local

government approach which must include the planning of our city and the settlements which are functionning inside the urban agglomeration. We also must engage in the debate about the impact of alternative urban policy visions on climate change. For example, this is an important context when we are debating the planning of higher density housing alongside better public transport corridors. Or considering decentralised commercial centres which minimise the need for people to travel long distances to work, and provide community infrastructure where people live.

The sustainable development of the capital can be conceived only in the Urban Agglomeration context, in which the municipality plays an active and stimulate part at a regional and metropolitan level.

This fact, along with the other components (industry, energy, agriculture, tourism) can be realized through the ensemble improvement of the public transport offer in Bucureşti, and the metropolitan area, and the fulfillment of the conditions which should ensure a better correlation between the offer and the future specific demand, the coordination of the development and modernization of the existing endowment, and the optimization of exploitation, through an efficient intermodal transport system.

These are some important subjects but not the only themes.

IMPACT OF THE ENVIRONMENTAL FACTORS ON THE URBAN BIODIVERSITY

Marilena Onete

The main problems challenging mankind during this century – the climate change, the loss of biodiversity and the increase of the human population particularly in the urban area – are closely interconnected (Sukopp et all., 1995). The biological diversity (biodiversity) represents the variability of the living organisms including the specific diversity of the ecosystems (terrestrial, maritime and other aquatic ecosystems), of the ecologic complexes they belong to (CBD, 1993). Biodiversity is the foundation on which the human civilisation is built. Man uses the biologic resources for survival and welfare, in an increasingly intensive manner over the recent decades. The biological resources include the genetic resources, organisms, populations or any other component of the ecosystems that can be used or has value for mankind (COP, 2002).

The human settlements, which developed as size and complexity in time, are not just important forms of human coexistence, but also important forms of the relations between man and the environment (Figure 1). Within the evolution of the human species, besides the biologic laws which govern the man and any other species, social laws emerged, based on the process of work (Botnariuc & Vădineanu, 1982).

Figure 1: Human settlements on the globe as revealed by the lights seen from the space (Source: NASA - http://www.globalwarmingart.com)

Thus, while all the other species on the Earth change, adapting to the environment, man, the dominant species on Earth, may transform the environment according to its needs.

The term of "urban biodiversity" is a combination of the terms "biodiversity" and "urban". The definition of biodiversity is the one adopted by CBD (1993) and by most ecologists, but the term has been used much with various meanings. This definition addresses not just the diversity of all living organisms, but also the different levels of organisation of life (ecosystems, complexes of ecosystems, etc.) in which the organisms are integrated and without which they can not exist self-sustained. For the term "urban" there also are various definitions (McIntyre et al., 2000). The term "urban (Latin: *urbanus*, urbs = town)" means "in relation with or located in a town, characteristic to the town or to the life in a town, forming or comprising a town".

Structures and processes within the natural ecosystems

The ecosystems are elementary structural and functional elements. A structural and functional model of the ecologic system can be identified during the real-time investigation of such system; this is a simplified (homomorphous) model produced by the aggregation of several components, which preserved the particularities of the organizational and space-temporal complexity of the ecosystem as a whole (Vădineanu, 1998).

There are several environmental factors acting on an ecosystem:

- abiotic factors:

• Geographical: geographical position on the globe (latitude and longitude), altitude, geographical setting, morphology of the ecosystem;
• Mechanical: wind (speed, intensity, etc.), water movement (level of ground water, rain fall, runoff water, etc.)
• Physical: temperature, light intensity, granulometry and soil depth, etc.
• Chemical: ion composition, salinity, oxygen, nutrients, etc.
• Climactic: macro-, mezo- ad micro-climactic

- biotic factors: of development, internal (age, stage of development, etc.), sex, interspecific relations (neutralism, competition, mutualism, etc.)

In the ecosystems in which the anthropic impact is low or absent, the high heterogeneity of the ecosystem components and the complexity of the relations developed during the process of evolution, determine the integrity, dynamic balance and self-regulation of the ecosystem and, implicitly, of its components. By increasing the diversity and stability to the action of disturbing factors, the natural ecosystems display a trend to increase the energy input into the system. The biological systems at different levels (individuals, populations), hierarchized and integrated within the biocoenotic system, function according to a cybernetic design in which any composing element, subsystem, is self-adjustable and at the same time adjusted by the higher system (Botnariuc, 1976).

Structures and processes within anthropised ecosystems

The anthropised ecosystems are ecosystems in which the action of humans plays a decisive role in their functionality. Man, in order to meet his necessities, aims to maximize the productivity of ecosystems, to increase the intensity and scope of exploiting the biological and non-biological resources, to introduce foreign species. The products of human activity are discarded in the natural ecosystems, most times exceeding their capacity of endurance, thus having deleterious effects on the ecosystems. By all his actions, man causes changes in the ecologic balances, in the trophic structure, in the biologic productivity starting from the level of an ecosystem and ending with the level of biomes and whole ecosphere.

Several complex relations are established within an anthropised ecosystem:

- Between pollutants: multiple synergic/antagonist interactions with positive or negative effects;
- Between pollutants and the abiotic factors: chemical interactions, changes in the way of transportation, in the activity of transformation, etc.
- Between the abiotic and biotic factors: changes in the specific composition, population density, multiple interactions within the structure of the ecosystem.
- Between pollutants and the biotic factors: changes in the specific composition, population density, accumulation or transformation of pollutants.

We defined by pollutants, the results of human activity which pay a destabilising (deteriorating) role on an ecosystem (overexploitation, introduction of new species and substances, wastes from human activity, dam construction, new buildings, infrastructure, land utilization pattern, etc). These factors act starting with the level of the individuals/communities and end with the level of the whole ecosphere.

In the anthropised ecosystems, the structural and functional parameters which characterise a biocoenosis change and so does the homomorphous pattern of the flow of matter and energy into the ecosystem. The transfer of matter and energy becomes linear, the complexity of the ecosystems decreases, self-regulation is accomplished only through human intervention.

Structures and processes within the urban ecosystems

The development of the human society promoted, in time, the intensification of the urbanization process. The emergence and development of towns was due to the economic development and to the increasing numbers of the human population, to the migration of the human population towards the industrialized urban environment (Sârbu, 1999). The phenomenon of urbanization, accelerating during the recent decades, caused a dramatic increase of the process of environmental anthropization. The town area and its components are highly heterogeneous spatially, technologically and informationally, and also in terms of human population. The result of human activities is materialized in daily inputs of raw materials fossil fuels, water, food and by a daily output of finished industrial products, pollution, wastes, materials which the natural environment can not assimilate. The urban systems, the industrial complexes, are parasitic systems in terms of energy, depending strictly on the energy

and raw materials from the natural systems which supply matter and energy (Vădineanu, 1998). The input of matter and energy to maintain the towns functional is very large. The solid, liquid and gaseous emissions are the largest output of the towns, which are inputs for the neighbouring areas and for the town itself (positive feedback) (Sukkop et all., 1990).

A town consists of a mosaic of biotopes (it has a heterogeneous structure), it is the location of biocoenoses in which the species have extremely variant biological necessities, so that the specific diversity of the urban areas is higher than that of the original ecosystems (Sârbu, 1999). The spatial structures of the town belong functionally to the socio-economic system, but ecologically, they are the elements of the biotope for the biocoenoses existing in the town. The accelerated process of anthropization makes the urban biotope and the biocoenoses from the urban areas to change continuously; the flows of matter and energy between the town and the natural environment change, the quality of these flows also changes (Petrişor, 2008).

Within the context of the changes produced by humans, Ellis & Ramankutty (2008) offer a new vision on the biosphere: the anthropogenous biomes. The humans control the biodiversity, the processes within the ecosystems, the climate. The authors specify that this is the reason why the maps of the current biomes are not realist because the area of the biomes changed or exists no longer. This area includes increasingly the urban and agricultural systems, the mosaic of woods, etc. The anthropogenic climactic changes alter the location and composition of the biomes. The ecosystemic processes are function of the human population density and function of the way the land is used, not function of the climacteric factors, as it happens in the natural ecosystemic processes.

There are multiple factors which affect biodiversity (implicitly the urban biodiversity, as well) and the influence one another reciprocally, while the responses of the various levels of organization of life are complex and interconnected both within the level, between the levels, and with the abiotic factors. The stressors are more powerful inside the towns (higher temperatures, low rainfall, pollution etc.) and they depress the resistance of the organisms, causing eventually their death. The town is an "heat-island" (Figure 2). The effect of the urban climatic factors of the green areas is dramatic.

The smaller and more simplified are the ecosystems, the stronger are the green areas from the towns affected by the biotic and abiotic environmental factors. The larger and more expanded are they, with corridors of transition between them; they influence the climate at a regional scale. They are new forms of existence or are changes of the old ones. The similarity between the old forms of the green areas and the new ones decreases from the periphery towards the downtown.

In towns, the plants are no longer the basis for the production of energy for the ecosystem and the decomposers play a minor role. In comparison with the neighbouring peri-urban and rural areas, the heterogeneity of the urban habitats is higher; most times they are fragmented and drastically separated from one another, the import of species (mainly vascular plants, some invertebrates, birds and some mammals) being dominant.

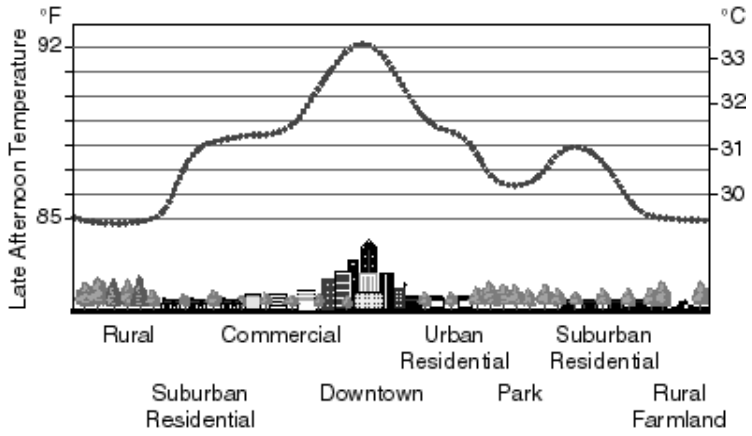


Figure 2: Sketch of an urban Heat-Island profile
(Source: Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, Heat Island Group -http://eetd.lbl.gov/HeatIsland/HighTemps/)

The people influence their life environment by introducing and eliminating species. The percentage of foreign species increases with the decrease of the native species. The species of exotic plants (brought purposely into the town due to aesthetic reasons, or brought accidentally) mainly, via various routes, exit the town and invade the neighbouring areas, the semi-natural and natural ecosystems, causing the biodiversity of these ecosystems to decrease. Most plant species observed downtown are exotic (foreign), most times with southern or Asiatic origin, and they live there supported directly or indirectly by man (Sukopp, 1990). Many species of animals and fungi also prefer the urban environment. Manu plant species (trees particularly) are common to the large European cities despite the climactic and biogeographical differences (Kunick, 1981). The urban biodiversity becomes thus levelled worldwide (Ignatieva, 2008). In Bucharest, because there is a desire for European integration under various aspects, a large number of Spanish Plane Trees (*Platanus hispanica*) have been planted in 2008, this tree being present in most European capitals.

Characteristics of the urban biodiversity

Because the urban ecosystems and, implicitly, the urban biodiversity submit primarily to the ecologic laws and thereafter to the social laws and to the laws of different nature, we present subsequently the structures and processes of the natural and anthropized ecosystems. Although we have spoken of the urban biodiversity within the context of the structure and processes of the anthropized ecosystems, we have to review the definitions of the urban biodiversity:

- The biodiversity includes the components (plants and animals) and the processes which support these components. The urban biodiversity is different from the biodiversity in general because it is affected by the alteration of the natural environment due to the human activity (Cilliers, 2008).

- The variability of the living beings from all the sources and ecosystems within an area with a high density of the man-made structures in comparison with the neighbouring areas (Petersen et al., 2007).

The urban flora and fauna has some characteristics, when compared to the non-urban flora and fauna (Wittig, 2008): the low percentage of the native species compared to the high percentage of the exotic (introduced) species; high proportion of thermophilic, draught-resistant species; high proportion of cosmopolitan and ubiquitary species and low proportion of the rare species or of the species from rare habitats; the urban flora becomes homogenous worldwide.

The urban environment has several characteristics in relation to the urban biodiversity:

- in urban-rural gradient, the biodiversity of the natural ecosystems which developed historically on the locations which are currently occupied by the town is shortly changed by the urban expansion and development.
- the native species from the neighbouring areas can "sneak" into town from the neighbouring areas, the urban environment thus becoming a *centre for immigration and adaptation*.
- the exotic (foreign) species brought by people, purposely or not, can adapt to the altered environmental conditions from the town, conditions which are sometimes closer to their native conditions of growth (most species coming from the Mediterranean area or from other warmer regions of the globe), the urban environment thus becoming a *centre for import and naturalization* of the foreign species. Once adapted to the urban environment, these species find various ways to spread within the rural environment, the urban environment being thus a *centre for export* of the introduced species.
- new taxa appear in the urban areas, adapted to the special ecologic conditions, new interactions develop between plants and animals; new habitats appear, created by the process of urbanization (residential areas, gardens, parks, railroads, barren lands etc.), the urban environment being thus a *centre of evolution.*
- the urban areas are *centres of hybridization* for many species of plants and animals.

The towns, as a whole, are "young" habitats for the species of plants and animals (Nowak, 2008). The urban biodiversity is not just a crucial component of the urban ecosystem, but it also bestows upon the town an important *ecological and cultural integrity*. The native (indigenous) components of the biodiversity are an important tool for the *ecologic and cultural identity*. The different historical origin and development of the towns determines different approaches in the attempt to understand the urban biodiversity (Ignatieva, 2008)

Importance of the urban biodiversity in the lives of the people

The urban biodiversity is of great value for research, biomonitoring, education, quality of life, socially/psychologically, aesthetics, economically, recreationally, health care etc. The benefits of the urban vegetation are many folded: improving air, water and soil quality; reduction of UV radiation; decrease air temperature; preserve the energy within the buildings; reduce the greenhouse effect gasses concentration; reduce the level of noise; survival of the wild life, etc.

We may say that the urban biodiversity is beneficial to human health (Tzoulas et al., 2007):

- socio-economic health: access to shelter (houses/apartments) and services, housing and working conditions;
- community health: culture, education, etc.;
- physical health: immunity, cardio-vascular, etc.
- psychological health: alleviate the stress load, positive emotions, etc.

The town can be seen as a laboratory in which the study of the urban biodiversity helps to improve the fundamental knowledge and to put them into practice within the conditions of the global climacteric change. Thus, looking towards the climate of the future we may advance solutions based solely on the knowledge of the benefits brought by biodiversity, on the knowledge of the ecologic processes and species biology: the restoration/regeneration or creation of woodlands, because the mature trees are known to be the oxygen "factories" and the ones retaining CO_2 which is the main greenhouse effect gas. The forests/green areas with a higher structural complexity play a determining role in changing the rainfall and temperature regimes, in changing the diversity and action of the pests, of the storms, etc. The species of robust, long life, plants (trees and shrubs), bedsides retaining carbon also have a major influence in the rainfall regime, in lowering the air temperature and the consumption of energy. The use of fossil fuels can be depressed by using rapidly growing species, with a long life cycle, which can regenerate naturally; we have to encourage the use of vegetation to produce energy. By researching and biomonitoring the urban biodiversity we can recommend the selection of the best suited species and their use for landscaping in order to alleviate the impact on the environment and human health. Understanding the importance of the urban biodiversity, man can understand he functioning of the urban system as a whole, in its dynamics, the role of the urban areas within the dynamics of the rural areas and of the neighbouring natural ecosystems. Man itself is host for numerous microorganisms; the changes produced by the urban environment to the man-microorganisms relation may trigger the emergence of new diseases. For instance, history shows that the development of the urban agglomerations and the movement of the human population from one area to another favoured the emergence of devastating epidemics in Europe.

Research and ideas for the future

As the towns expand very much in space, they can not preserve and save the world ecosystems and species (Müller et al., 2008). However, when they are in direct contact with the nature, men are open to observe the importance of the actions to preserve and restore the natural and semi-natural ecosystems. Being in contact with the urban biodiversity, improves the experience with the nature. The urban "jungle", with many introduced species, might be the field for present time actions of conservation, for understanding and preserving the species of the future.

The urban biodiversity might be the key to the plans for the conservation of the global biodiversity.

It is absolutely necessary to achieve the integration of the research and education in maintaining, enriching and understanding the urban biodiversity in urban planning too.

The towns are a new type of ecological entity and a new level of complexity and organization; hence they have to be studied as integrated organisms.

The urban ecology has been defined (Cilliers, 2008) in different ways in time.

1. Ecology and evolution of the organisms (ecosystems) living in towns
2. Biology, policy, economy and culture of urban *Homo sapiens*

3. The towns are emerging phenomena of the joint human and natural processes that affect the evolution and survival of the human species and the survival of other species, the integration of the social with the bio-geo-chemical processes.

In order to connect the urban ecology with the urban planning, connection which is absolutely required by the human welfare and health, we need interdisciplinary and transdisciplinary research. Solid comparative studies are required, the collaboration between researchers in various fields of activity, studies which to rely on the urban biodiversity at the level of the house hardens, parks, town districts, up to the level of the town as a whole and its neighbourhoods. The protection of the urban biodiversity and, implicitly, of the human health, must include practices of sustainable development: green roofs and buildings, use of solar energy through various methods, river water management by creating adjacent wet areas, waste sorting and recycling, development of an infrastructure for compost making ("green" waster recycling) (Ignatieva, 2008). The urban ecology is the ecology of the future (Cilliers, 2008).

While in 2007, 50% of the global population used 2% of the land area and 75% of the global resources, it produced 80% of the global carbon dioxide and is accountable for the major loss of biodiversity, in 2030, 61% of the world population will use 3.5% of the global land area, but not forecasts can be given for the percentage of global resources utilization, for the global production of carbon dioxide or for the loss of biodiversity (Müller et al., 2008).

To reduce the rate of biodiversity loss, solutions have to be found for the rapidly growing towns. Biodiversity is essential to the human health and to the vitality of the urban areas. We can afford to remove nature from the town. It is not about the quality of life, but on protecting life itself (CBD, 2008).

The rate of biodiversity loss is unprecedented, endangering the existence of life itself. Maintaining biodiversity is necessary for the sustainable development, it is one of the most important challenges for the modern world (COP, 2002).

The need of urban ecology in environmental management

In the cities, with biotopes overwhelmed by buildings and asphalt, they are necessary studies using ecological methods. This is the subject of urban ecology. (Sukop et al., 1990).

Investigation of flora and fauna, showed that even in man-made sites, characteristic combination of organisms (plants and animal communities) lives together in the cities, as in natural habitats where they evolved together over the millennia. The ecosystems from the city, in spite of the dominant species, human

beings, are amenable to the ecological principles. Over the centuries, the natural ecosystems shrunk or disappeared once with the development of the city.

The results of humans' activity lead to air, water and soil pollution and changes in climate much faster for flora and fauna to adapt of the new created conditions. This determines the rapid loss of biodiversity.

Thus, the development of urban ecology as a subdiscipline of ecology is very useful (Trepl, 1995). The theory of urban ecology has been developed over years by numerous scientists. In many big cities of the world, the urban ecology is in practice.

Environmental bioindicators, represent a complementary tool for environmental monitoring systems, and could also overcome some of the shortcomings associated with the direct measurements of pollution.

THE IMPORTANCE OF VEGETATION COVER IN URBAN PLANNING

Marilena Onete, Mihaela Paucă-Comănescu

The general characteristics of urban vegetation:

- native/indigenous flora contain the most suitable species for air pollutant accumulation;
- native/ indigenous species can be used as response bioindicators; they have visual impact of the people and develop awareness of the public by improving their knowledge about response of the plants to air pollution impact
- some of non-native species planted in the parks for amenity reasons it is possible to became invasive
- the spread of non-native plant species produce changes in microorganisms, invertebrates and vertebrates species communities
- trees are the main driver of retaining pollutants in their barks and of producing changes in air chemical composition
- trees, shrubs and herbaceous vegetation change soil and water chemical composition
- maintain the microorganisms, invertebrates and vertebrates species' diversity and is the natural regulative of the disturbances in invertebrates populations
- Native/indigenous flora vegetate in all biotopes in the city (remnant forests, group of trees, shrubs, lawns and even wastelands)

Urban vegetation benefits:

- Improve air and water quality
- Reduce UV radiation
- Decrease air temperature
- Preserve energy inside the buildings
- Reduce the concentration of greenhouse gases
- Reduce the noise
- Permit the survival of wildlife
- Aesthetic
- Social/psychological
- Human health

An overview over the vegetation from central parks from Bucureşti

There is a shortage of distributional data for plants available for Bucharest. Based on published data, Mucina (1990) concluded that Romanian botanists (Morariu, 1943; Spiridon, 1973) had made contributions to the syntaxonomy of ruderal

vegetation and several researchers had contributed importantly to the present knowledge of urban vegetation in Romania. All the published papers (Morariu, 1943; Sanda & Popescu, 1971; Popescu *et. al*., 1971; Nedelcu et al., 1972; Spiridon, 1973; Anastasiu, 1994) describe studies made in the peripheral areas of the city or on sites with naturalised and ruderal vegetation within it. The only overview of the flora is restricted to trees (Prodan, 1922). From all mentioned papers none was focussed on parks with synanthropic vegetation (plant species which occur primarily associated with human activity) comprising ruderals (plant species which occur on disturbed and waste ground), planted and stress-tolerant species (Grime et al., 1988).

Inventories of the plants of three central parks (Cişmigiu, Izvor and Unirii) and adjacent forests (Băneasa and Baloteşti) have been carried out in the framework of LIFE AIR-AWARE project, following the gradient urban-rural to establish the main bio-indicators of air pollution.

We recorded the plant species, separating them into major groups (trees, shrubs and herbaceous) and the bio-indicators were noted.

The inventory of all plant species from all three parks were carried out in areas according with Figure 1. The plant species diversity has been recorded in areas shaped by man-made paths (asphalt alleys, walk paths).

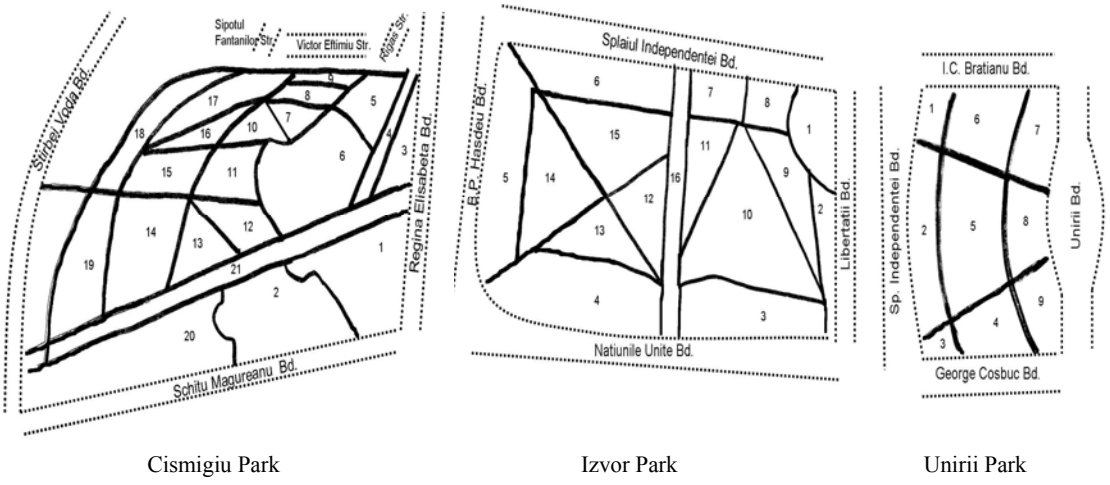


Figure 1. Diagrammatic division of the central parks from Buureşti city and the proximity of the main traffic roads.

Soil and plants samples for performing chemical analysis were collected on transects close to all edges of the parks, by the major roads and on transects throughout the middle of the park. Due to the richness of the vegetation at the edge of the parks, the air pollution should be diminished through the middle of the park (especially for Cişmigiu Park). The collection of plant samples was based not only on proximity of the main traffic roads but also on their presence in more sites. Where one species was present in only one site, the samples collection was based on the knowledge about the bioindicator status of the species.

Soil samples have been collected using Corer devise with 10 cm diameter and 10 cm length.

Vegetation samples have been washed with double distilled water; the analysis of washed leave samples provides elemental concentration in leaf tissue. The vegetation samples were dried at 40^0 (for not loosing the volatile metals).

Soil and vegetation samples have been grinded with Planetary Ball Mill PM 100, sieved and kept in plastic bags for farther analysis. For analyzing the samples they have been digested with HNO_3 and hydrogen-peroxide 30%. Heavy metals (Pb, Cd, Cu, Zn) from soil and plant samples have been analysed with Perkin Elmer AAnalyst 800 Atomic Absorption Spectrophotometer incorporating all spectrometer and atomizer components using graphite furnace or flame techniques.

The separation in different shaped areas is due to man-made paths margined (or not) by benches. The usage of the quadrates it was not appropriate in Cişmigiu due to the irregularity of the areas. An exact list of all plant species with an attendant visual estimate of their sociability and abundance is taken from the samples areas. We used DAFOR scale to measure the frequency and cover of the different plant species as follows: dominant (>75% cover), abundant (51-75% cover), frequent (26-50% cover), occasional (11-25% cover) and rare (1-10% cover) (JNCC, 2003, 2006). This scale is highly visual of class typical abundance and frequency, i.e.: the dominant vegetation / species is highly visible, the abundant consists from many individuals or patches visible, frequent means several individuals or few patches, occasional means a small patch or a few individuals, rare imply single very small patch or individual, all of these classes having the coverage specified before.

The trees registered in all three parks are more frequent in Cişmigiu Park, this park being the most complex comparing with other two parks (Figure 2 and 3). Most abundant are the native trees, making this park more stable then the others. The shrubs are mainly cultivated, the park managers handling in an easier way the shrubs than the trees. The ecological requirements of trees and shrubs are variant, most of the species being mesophyte (species adapted to neither a particularly dry nor particularly wet environment), mesothermic (species accommodated at 15^0C mean annual temperature) and acido-neutrophilic to poorly acido-neutrophilic (species preferring pH=6-7) (Figure 6).

The herbaceous species are large broad tolerant and mesophyte, mesothermic and acido-neutrophilic to poorly acido-neutrophilic, the nutrient availability of the soil being low. The works of parks maintenance remove the natural organic matter (*i.e.* litter in autumn), being necessary inorganic supplements.

Either woody (trees and shrubs) or herbaceous species can be:

- Native – indigenous plant species growing naturally in the area;
- Cultivated - native or exotic species cultivated for different reasons,
- Ruderal – species first colonizing disturbed land. These species, when the soil is covered with a foreign substance, may for a single-species community and become permanently established. Sometimes, some ruderal invasive species may replace the natural species (being strongly competitive).
- Segetal – weeds growing in sown fields/crops.

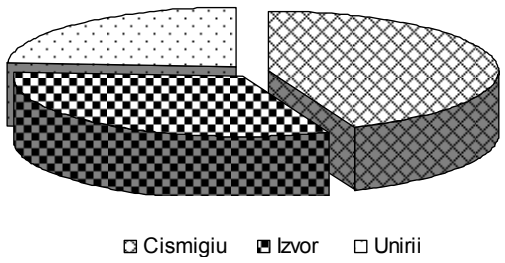


Figure 2. The frequency of trees and shrubs in Cişmigiu, Izvor and Unirii Parks

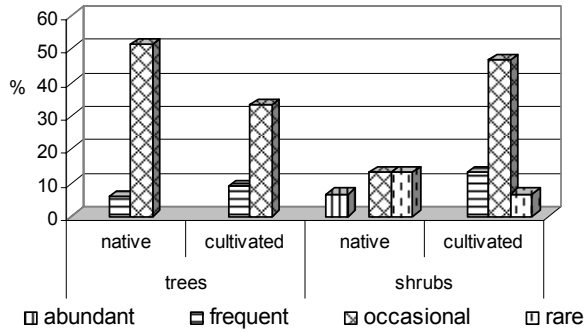
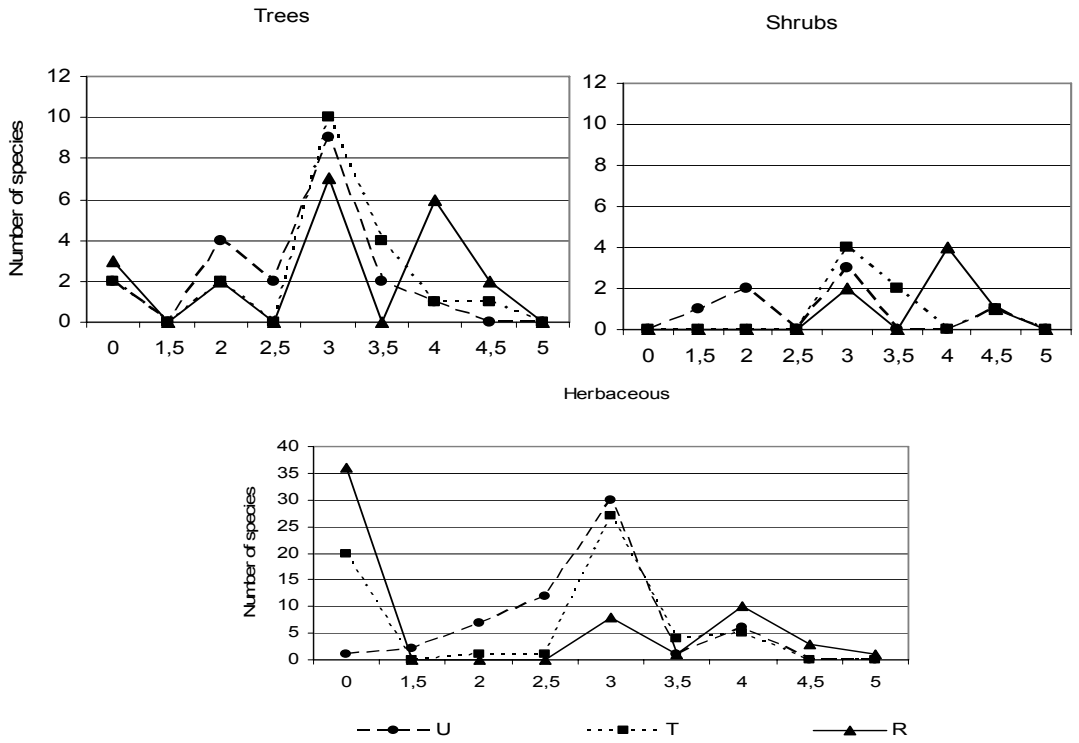


Figure 3. The frequency of native and cultivated trees and shrubs in Cişmigiu Park



Legend:

U – humidity indices (0: large broad tolerant; 1: xerophyte; 2: xeromesophyte; 3: mesophyte; 4: mesohydrophyte; 5: hydrophyte) ; T – temperature indices (0: large broad tolerant; 1: cryophyte; 2: microthermic; 3: mesothermic; 4: moderate thermophile; 5: thermophile); R: Soil reaction indices (0: large broad tolerant; 1: very acidophilic; 2: acidophilic; 3: acido-neutrophilic; 4: poorly acido-neutrophilic; 5: neutro-basophilic)

Figure 4. Ecological indices of the plant species from Cişmigiu Park

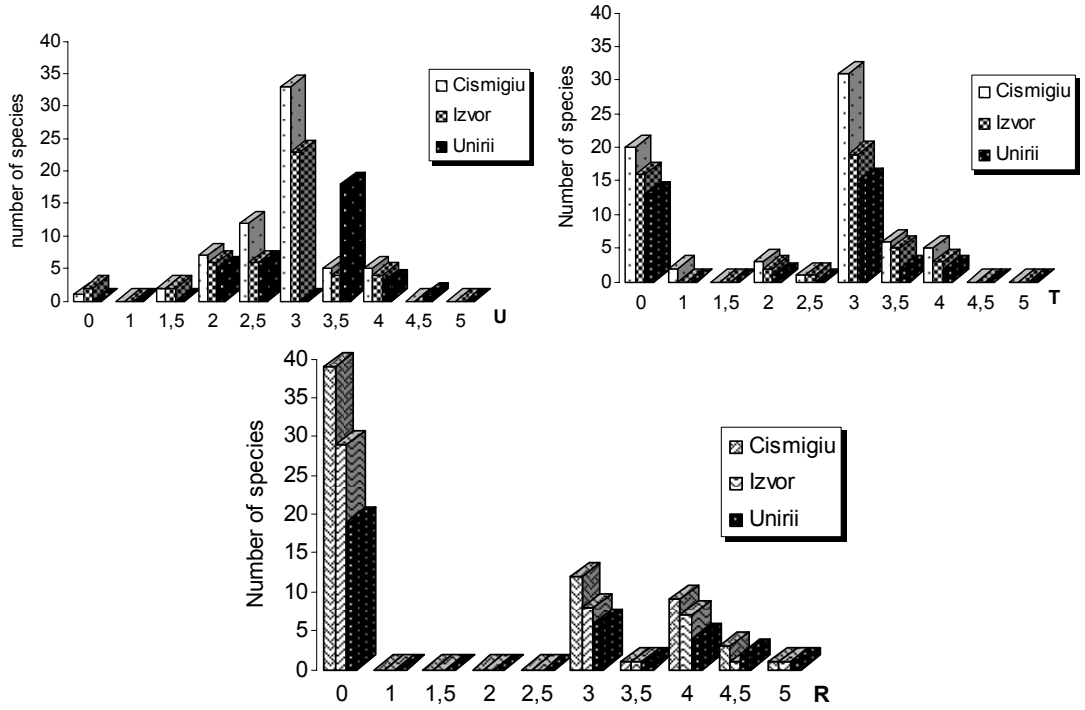


Figure 5. Ecological indices of herbaceous plant species from all three Parks

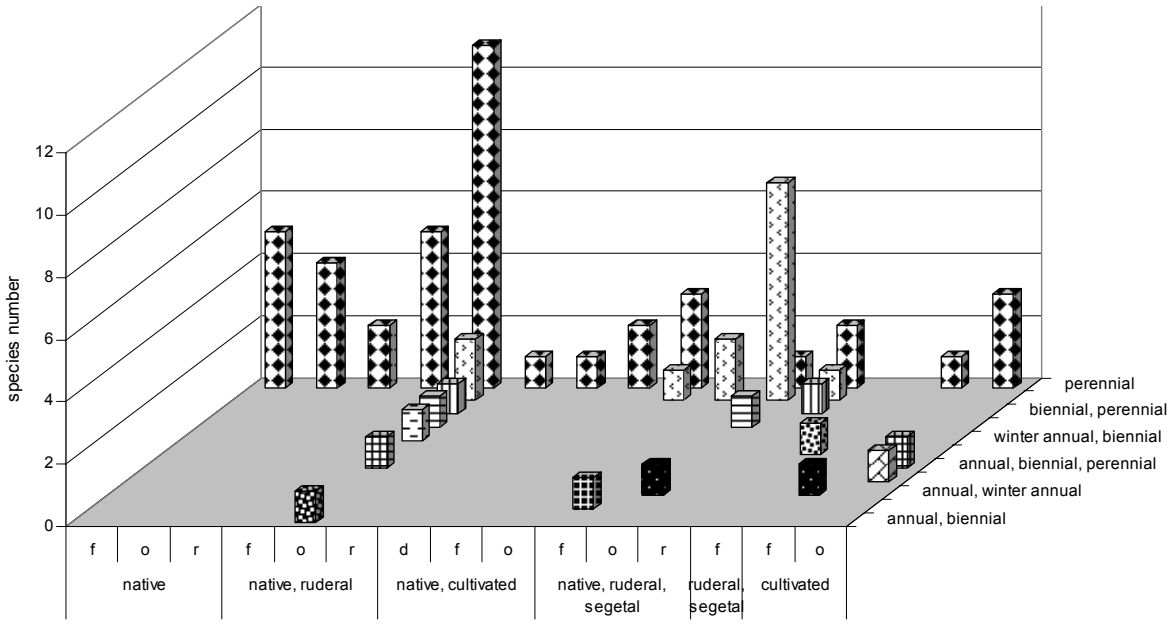


Figure 6. The relative abundance of different categories of herbaceous species from Cişmigiu Park

As it is shown in Table 1, the trees distribution at the country level is mainly in the steppes-oak zone in which Bucureşti is situated. Most of the plants species used usually for different purposes are native species, especially do to their resistance in natural environment for which they are adapted. Also knowledge about native species is higher. Changes in the specific composition structure of different planted areas determine changes in the relationships between plants and animals. In the urban environment new taxa may appear (adapted at the specific conditions of urban environment), and also new habitats created by urbanization (residential areas, gardens, parks, railways, brownfields). New introduced exotic species can destabilize the urban ecosystems already affected by other environmental factors.

Using the knowledge following the inventory of the plants and animals and monitoring of bioindicator species from the central parks from Bucureşti and the forests from the outskirt of the city, we can state that humans affect the city by introducing species for aesthetic and amenity reasons.

In the sylvo-steppe zone where Bucureşti is situated, the native/indigene flora is adapted to the temperate environmental conditions. In the "heat-island" of the city, the exotic/alien species brought from countries situated near by Equator, are already adapted at the urban conditions and may replace the native species, changing plants and animal communities due to increased death rate.

Urban flora and associated fauna, across Europe and entire world, present a homogenization. Exotic species are planted in the cities from aesthetic reasons. Many native/indigenous plant species "creep" into the city. Whether they survive from the former forests that once covered the same place instead of concrete buildings and streets, or they spread into an environment created by human beings for themselves.

In the parks from Bucureşti, the natural vegetation had mainly disappeared, being replaced by planted species (especially trees brought from China, Japan, America, *etc*). Remains of the natural vegetation adapted to the modified conditions of the city (either fertilisation or lack of the nutrients, changes in soil pH, increased temperature, *etc*.) because of the pollution.

Where park maintenance work (usage of fertilisers, irrigation/watering, sowing *etc*) is not applied, the vegetation cover in all three parks becomes very much degraded, with large expanses of bare ground.

In the centre of Cişmigiu, Izvor and Unirii Parks were planted *Viola* x *wittrockiana and Calendula officinalis* and sown *Lolium perenne, Poa pratensis, Festuca arundinacea* – all introduced for the park's aesthetic (Photo 1).

In Cişmigiu Park, in areas by fences, under the trees, the herbaceous layer is very open with much bare ground but rich in ruderal species when compared with the sown areas where the dominant species are few, and derived from seed-mixtures used by the park administration. The herbaceous vegetation is also sparser both under the trees where the competition for light is strong and where trampling is intense (Photo 2).

Table 1: The characteristics of woody vegetation registered in central parks of Bucureşti

Species	**frequency**	**Distribution**							**Usage**											**Status**
		z.st.	**z.si.**	**z.stej.**	**e.g.**	**e.f.**	**e.b.**	**e.s.**	**parks**	**gard**	**fence**	**for**	**cour**	**ind**	**alim**	**med**	**mel**	**anti**	**pion**	
Trees																				
Acer negundo L.									1		1	1	1							cultivated
Acer platanoides L.	frequent								1			1								native
Acer pseudoplatanus L.	frequent								1			1								native
Aesculus carnea Hayne	sporadic								1											cultivated
Aesculus hippocastanum L.	frequent								1											cultivated
Ailanthus altissima (Miller) Swingle	frequent								1											native, cultivated
Amygdalus communis L.	frequent								1			1								cultivated
Betula pendula Roth	frequent								1					1					1	native, cultivated
Carpinus betulus L.	frequent										1	1								native, cultivated
Catalpa bignonioides Walter	frequent								1											cultivated
Celtis australis L.	very frequent								1											cultivated
Cerasus mahaleb (L.) Miller	sporadic												1	1	1					native, cultivated
Chamaecyparis lawsoniana Parl.	frequent								1	1	1									cultivated
Corylus colurna L.	rare								1			1			1					native, cultivated
Fraxinus americana L.	frequent								1			1								cultivated
Fraxinus excelsior L.	frequent								1			1		1		1				native, cultivated
Ginkgo biloba L.	rare								1											cultivated
Gleditsia triacanthos L.	rare								1		1			1						cultivated
Juglans regia L.	frequent													1	1	1				native, cultivated
Morus alba L.	frequent								1	1		1			1	1	1			cultivated
Morus nigra L.	sporadic								1	1				1	1	1				cultivated
Paulownia tomentosa (Thunb.) Stend.	rare								1											cultivated
Picea glauca (Moench.) Voss.	rare								1	1										cultivated
Pinus sylvestris L.	sporadic								1			1		1		1	1			native, cultivated

Platanus hispanica Miller ex. Muench.	frequent								1											cultivated
Populus alba L.	frequent																			native, cultivated
Populus nigra L. cv. *italica* Moench.	frequent								1			1		1		1	1	1		cultivated
Populus tremula L.	frequent													1						cultivated
Prunus cerasifera var pissardi (Carririere) C.K.Schneid.	frequent								1											cultivated
Quercus cerris L.	frequent													1						native, cultivated
Quercus robur L.	frequent											1		1						native, cultivated
Quercus rubra L.	frequent								1			1								cultivated
Robinia pseudoacacia L.	frequent								1			1		1		1	1	1		native, cultivated
Salix alba L.	frequent								1											native, cultivated
Salix babylonica L.	sporadic								1	1										native, cultivated
Salix fragilis L.	frequent																			native
Sophora japonica L.	rare								1			1								cultivated
Thuja orientalis L.	very frequent								1	1										cultivated
Tilia cordata Miller	sporadic								1			1				1	1			native, cultivated
Tilia platyphyllos Scop.	sporadic											1				1	1			cultivated
Tilia rubra D.C.	sporadic								1											cultivated
Tilia tomentosa Moench.	frequent								1			1		1		1	1			native, cultivated
Ulmus glabra Hudson	frequent								1					1						native, cultivated
Ulmus minor Miller	frequent								1					1						cultivated
Shrub-trees																				
Acer tataricum L.	frequent								1			1								cultivated
*Albizia julibrissin*Durazz.	sporadic								1											cultivated
Buxus sempervirens L.	sporadic								1	1										cultivated
Cornus mas L.	frequent								1						1					native, cultivated

Rhus hirta (L.) Sudworth	sporadic								1											cultivated
Sambucus nigra L.	frequent															1				native, cultivated
Shrubs																				
Berberis julianae C.K. Schneider	rare								1											cultivated
Berberis vulgaris L.	sporadic																			native, cultivated
Cornus sanguinea L.	frequent																			native, cultivated
Corylus avellana L.	frequent														1				1	native, cultivated
Cotoneaster simonsii Baker	rare								1											cultivated
*Euphorbia pulcherrima*Willd.ex Klotsch.	rare								1	1										cultivated
Forsythia europaea Degen. et Bald.	sporadic								1	1										cultivated
Hibiscus syriacus L.	rare								1											cultivated
Ilex aquifolium L.	rare								1											native, cultivated
Juniperus horizontalis Moench.	frequent								1	1										cultivated
Ligustrum vulgare L.	frequent										1			1		1				native, cultivated
Lonicera korolkowii Stapf									1											cultivated
Lycium barbarum L.	sporadic																			cultivated
Mahonia aquifolium (Pursh) Nutt.	frequent								1	1										cultivated
Rosa canina L.	frequent														1	1			1	native
Rubus caesius L.	frequent																		1	native
*Rhododendron sinogrande B*alf. et W.W.Smith									1											cultivated
Spiraea alba Duroi									1	1	1									cultivated
Symphoricarpos albus (L.) S.F. Blake									1											cultivated
Syringa vulgaris L.	sporadic								1	1										native, cultivated
Tamarix tetrandra Pallas ex. Bierb.									1											cultivated
Viburnum rhytidophyllum Hemsl.									1											cultivated

Tree-shrubs																				
Crataegus monogyna Jacq.	frequent																			native
Taxus baccata L.	sporadic								1											native, cultivated
Lianas																				
Hedera helix L.	frequent								1											native, cultivated
Parthenocissus tricuspidata (Sieb. et Zucc.) Planch.	sporadic								1											cultivated
Wisteria sinensis (Sims) Sweet.	rare								1	1										cultivated

Legend:

Native species' distribution zones: z.st. –steppic zone; z.si. – sylvo-steppic zone; z.stej. – oak zone; e.g. – durmast zone; e.f. – beech zone; e.b. – boreal zone; e.s. – subalpine.

Grey colour – the zones covered by plants' distribution

Species utility: parks – ornamental; gard - gardens; fence – green fences; for - forestry; cour - protection curtains; ind – industrial; alim – alimentar; med – medicinal; mel – melifer; anti – anti-erosion; pion – pioneer.

1 – an arbitrary nmber for highlighting the species usage.

In Izvor Park, during summer, the herbaceous layer is poor in species, degraded and dry. Some areas have become largely bare ground. The leaves of the trees were covered in dust, to a greater or lesser extent, depending upon their external structures (trichomes, no wax, *etc*) which retain dust from the air. The most affected was *Tillia cordata*, which was also attacked by defoliating invertebrates (Photo 3).

In Unirii Park, the herbaceous layer is poor in species, affected by the visitors with large expanses of bare ground. Due to trampling, the seed dissemination of annual *Polygonum aviculare* is intense in both Cişmigiu and Unirii Parks, young and small individuals covering the bare ground, offering conditions for other seed plant establishment and survival. *Polygonum* is the dominant species in some large areas.

The combination of natural stress factors over-intensified in the city (higher temperature because of heat-reflecting asphalt and concrete, less precipitation, *etc.*) and intensification of pollution cause the decrease of plant resistance to the stress factors and their eventual death. The specific richness clearly decreases and plant populations further reduce their distribution areas already affected by fragmentation (due to trampled trails made by humans as short-cuts to the engineered asphalt paths).

During the autumn, when the environmental conditions are more suitable for plant life, late flowering and individuals with vegetative spread (clonal plants) were observed occupying the bare soil created during summer. Therefore, in Izvor Park, where the anthropogenic impact is most intense, we observed well developed populations of *Achillea millefolium, Agrostis stolonifera, Cynodon dactylon, Dactylis glomerata, Polygonum aviculare, Trifolium pratense, Trifolium repens, Potentilla reptans* etc. In Unirii Park, there were extensive spreading populations of *Polygonum aviculare* and *Achillea millefolium* (Photo 4).

In both Izvor and Cişmigiu Parks, "hidden" less trampled areas, among trees and soil poor in nutrients had a largely ruderal vegetation: *Arctium minus, Atriplex patula, Brassica oleracea, Capsella bursa-pastoris, Chelidonium majus, Cirsium vulgare, Conyza canadensis, Lamium album, Malva neglecta, Solanum nigrum, etc*. There, the maintenance work it is not applied because it not cause any harm of the park aesthetics.

Alongside ruderal vegetation, some wild species with wide distribution were brought into the parks by wind and birds*: Daucus carota*, *Typha latifolia, etc.*

Analysing the ecological indices of the vegetation from all three parks, we can state that the most species live on different soil conditions (they don't have preferences for a specific soil humidity, natural substances composition, etc.), in Cişmigiu and Izvor. In Unirii, the majority of the species need more humid soil, therefore, where the soil if dry and cracked, the vegetation cover disappeared.

The large tolerance of the species for large scale of the environmental factors is due to the fact that all species are frequent in Romania from the steppe zone to the boreal zone, adequate very well in the sylvo-steppe zone in which is situated Bucureşti city. In Cişmigiu Park, more non typical species for the zone grow around the lake finding the natural conditions for their life cycle. In Izvor, in a depression formed by the western fen, where a wetland has been developed, *Typha* and *Phragmites* species appeared being no typical for the park. These species show the resistance of the wild plants in the urban conditions.

Photo 1: The planted species for aesthetic reasons in Cişmigiu (left photo) and Izvor (right photo) Parks

Photo 2: Cişmigiu Park: dry herbaceous layer (up left), *Aesculus hippocastanum* injuries (up right), bare soil (down left), specialist taking soil and vegetation samples (down right)

Photo 3: Defoliators attack (upper photos) and dust on *Quercus* (left down) and *Tilia* (right down) species

Photo 4: *Alchemilla* population extent from Izvor Park (left), visible injuries on leaves trees along Splaiul Independenței Boulevard (right)

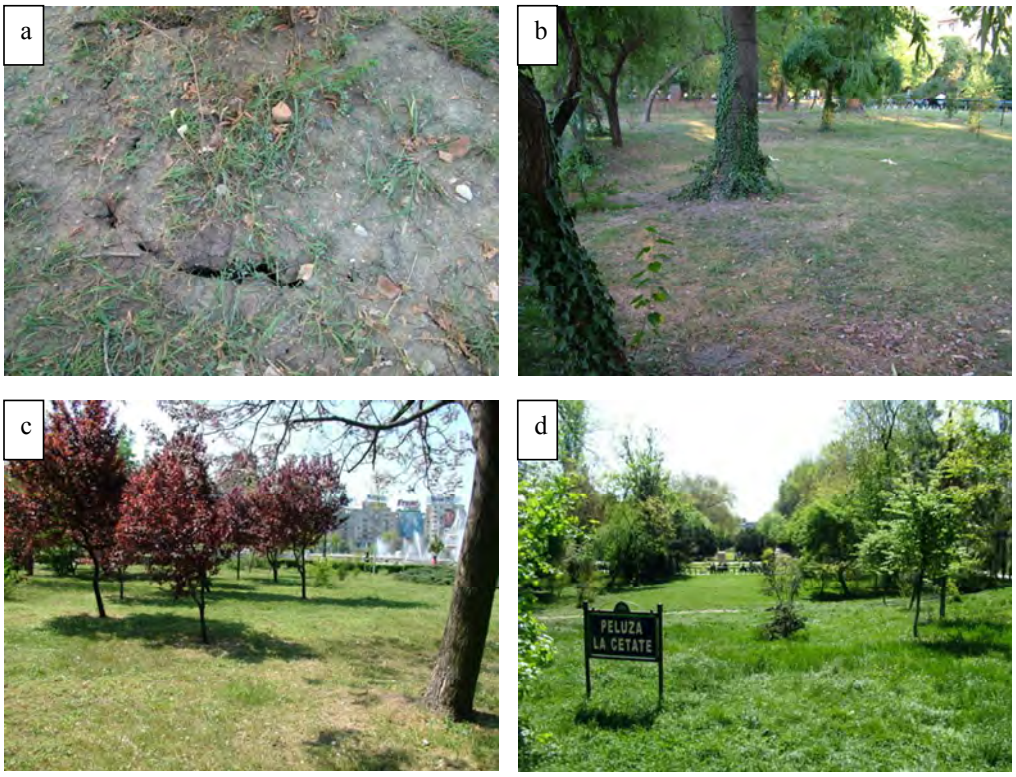


Photo 5: Soil and vegetation appearance in August 2007 in Unirii (a) and Cişmigiu (b), May 2007 in Unirii (c) and April 2007 in Cişmigiu (d)

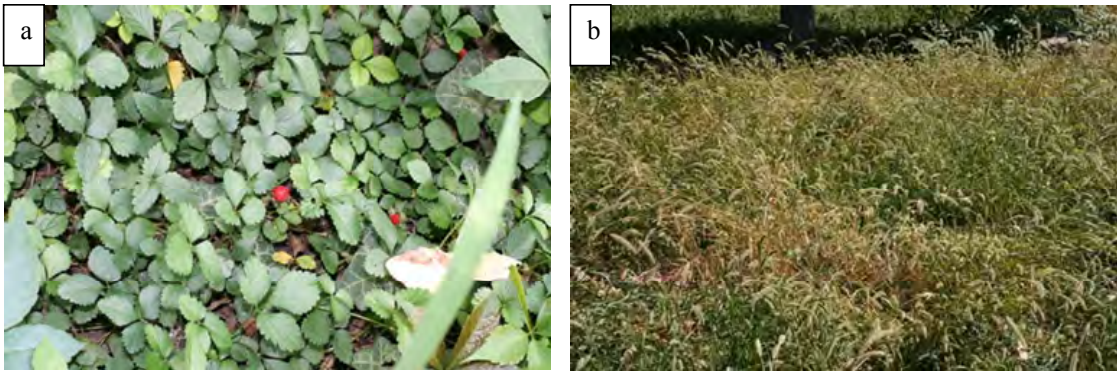


Photo 6: November 2007: *Fragaria viridis* in Cişmigiu (a) and grasses in Izvor (b) Parks

In 2008, the wetland was destroyed, park manager thinking that they spoil the aesthetic of the park. The park manager didn't know that *Typha* and *Phragmites* are among the best accumulators of the heavy metals in their tissues contributing to the water and air pollution decrease; that the wetland itself is a buffer for pollution.

Soil relative humidity for parks is lower than for forests from outskirts of the city; in parks, the asphalt or concrete alleys or/and paths without vegetation and surrounding high circulated boulevards hit the atmosphere increasing the water evaporation from the soil

During summer, the soil is cracked and nude or with scarce vegetation; where vegetation exists is dry (till late in September or even October), but in spring and autumn, the vegetation is green with perennial plant population starting to develop in November. We can argue that the plants changed their phenology in the city (Photo 5).

For instance, *Fragaria viridis* flowers usually in Mai – June but we found fruits in November 2007. Perennial *Phleum pratense* flowers normally in June-August; we found a good development of the population in November 2007 (Photo 6) following mowing of the entire vegetation and very hot period in summer, when the vegetation cover was represented by scarce individual of *Cichorium intybus* and *Medicago sativa*. *Phleum* and *Setaria viridis*, develop together in the same period of year, when abiotic factors (including soil and air humidity) offer them the optimal conditions for growing and development.

Using plants as bioindicators of air and soil pollution

Bucharest is the biggest and the most polluted city from Romania. The city centre present an increased air and soil pollution due to traffic agglomeration and other diffuse sources. The central parks have been chosen in accord with their different structural diversity. Following the inventory of plants from all three parks, chemical analyses have been performed. The chemical analysis of soils and plants from the central parks from Bucharest revealed that the heavy metal content of these components of the urban environment is different according with: the site complexity, the proximity with the main traffic roads, parks management and plant species.

In the central parks from Bucharest (Cişmigiu, Izvor and Unirii), the heavy metal concentration in the soil is highly heterogeneous being different at the entire park level, micro-site level and even at the point-like level. The heavy metal input can be realized both from atmospheric dry and wet depositions and from the soil itself (usually being brought from other sites more or less polluted). The proximity of intense traffic roads as major and intensive source of air pollution, leads to depositions on the soil and vegetation, influencing the heavy metal concentration in the soil.

The content of heavy metals in plants distinguish that the metal uptake from soil is different with different plants species. In the same park, the uptake of the metals is different both with different sites and distance to the main traffic road.

The chemical analysis of the plants tissues and dust deposition on the plants (Table 3) revealed that the content in heavy metal is very different in different sites from all three parks (I – Izvor, U – Unirii, C – Cişmigiu Parks) and references forests (Ban – Băneasa; Bal – Balotesti forests) (Onete et all, 2008). Based on plant's tissue content of heavy metals (Table 3) we can argue that the metal uptake from soil is different with different plants species.

In the same park, the uptake of the metals is different both with different sites and distance to the main traffic road. For instance, *Buxus sempervirens* individual analysed from Cişmigiu Park, accumulate more Pb and Zn from the site near by traffic road than, the individuals from inside parks. The metal concentration in plants is affected by prevailing weather conditions, the water solubility of deposited metal-containing particulates, the nature of the plant surface, plants root uptake of the metals, etc. (Bache et al., 1991). Metal uptake in higher vascular plants takes place through their root system, additionally through the leaves and, therefore, it is difficult to distinguish whether the accumulated elements originate from the soil or from the air (Harrison and Chirgawi, 1989).

Exceeding the normal range of metals in plants means that the metals become sufficient or toxic and excessive (Pais and Jones Jr., 1996; Kalra, 1998). Heavy metals (and other chemical) are taken up by plants from soils and transferred through the terrestrial invertebrates and vertebrates (including humans) via respiration and ingestion. Plants influence and are influenced by their environment. The chemical composition of plants reflects, in general, the element composition of the growth media.

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The heavy metal concentration in plants tissues as well as in the soil is affected by atmospheric heavy metal concentrations.

Table 2: The levels of heavy metals' concentration (mg/kg d.w.) in plants according with different authors

		Pb	**Cd**	**Cu**	**Zn**
typically found in plants*	normal	0,1 - 10	0,2 - 0,8		
	toxic		>2		
approximate concentrations of trace elements**	sufficient or toxic	5 - 10	0,05 - 0,2		
	excessive	30 - 300	5 - 30		
Micronutrients***	deficient or normal	1		2 - 5	10 - 20
	sufficient or toxic			5 - 30	27 - 100
	excessive			20 - 100	100 - 400

* Pais & Jones Jr., 1996; ** Kabata - Pendias & Pendias, 1994; *** Kalra, 1998.

Table 3. Range content (mg/kg d.w.) of heavy metals in soil and plants' tissues

Name		Pb	Cd	Cu	Zn
Soil	Cişmigiu	32,3 - 199,8	0,47 - 1,21	24,6 - 168,5	104,6 - 330,3
	Unirii	27,68 - 104,6	0,36 - 0,8	19,16 - 105	64,81 - 214,5
	Izvor	15,02 - 92,87	0,44 - 0,78	12,32 - 89,74	63,94 - 194
Trees					
Acer tataricum L.		0,47 - 0,9	0,22 - 0,3	1,02 - 2,47	8,77 - 18,49
Amygdalus communis L.		2 - 3,49	0,1 - 0,38	2,4 - 3,83	9,23 - 11,8
Catalpa bignonioides Walter		1,25 - 3,73	0,14 - 0,79	2,73 - 7,12	8,93 - 13,61
Fraxinus angustifolia Vahl.		1,57 - 7,77	0,22 - 0,41	1,73 - 2,6	5,22 - 7,6
Fraxinus excelsior L.		0,59 - 2,63	0,25 - 0,45	3,76 - 5,08	7,81 - 11,7
Malus medzweltzkyana Dieck		1,79 - 3,03	0,2 - 0,34	3,09 - 5,35	6,93 - 9,45
Pinus sylvestris L.		1,1 - 1,44	0,22 - 0,27	1,05 - 1,99	9,18 - 14,27
Platanus hispanica Miller ex. Muench.		1,16 - 2,28	0,18 - 0,60	1,74	7,90
Populus nigra L. cv. *italica* Moench.		1,16 - 4,96	0,33 - 0,47	2,81 - 3,67	11,4 - 44,43
Quercus cerris L.		0,43 - 0,78	0,31 - 0,33	3,43 - 3,67	13,34 - 16,19
Quercus robur L.		2,19 - 3,59	0,22 - 0,83	4,44 - 6,89	10,41 - 16,99
Quercus rubra L.		1,24 - 3,34	0,26 - 0,53	1,18 - 9,97	6,13 - 21,05
Thuja orientalis L.		1,38 - 8,74	0,13 - 0,56	2,75 - 6,69	11,50 - 17,34
Tilia argentea		3,05 - 3,55	0,23 - 0,29	3,56 - 4,6	9,08 - 9,56
Tilia cordata Miller		1,07 - 8,93	0,14 - 0,68	2 - 10,51	6,38 - 20,43
Tilia tomentosa Moench.		1,28 - 3,05	0,21 - 0,23	2,81 - 4,6	6,38 - 9,56
Ulmus minor Miller		2,32 - 5,33	0,22 - 0,47	3,63 - 6,44	12,84 - 15,36
Tree - Shrubs					
Buxus sempervirens L.		2,20 - 7,68	0,11 - 0,37	2,49 - 33,30	9,30 - 15,61
Crataegus monogyna Jacq.		0,38 - 4,51	0,58 - 0,92	2,53 - 3,28	8,18 - 13,28
Shrubs					
Cornus sanguinea L.		1,4 - 3,81	0,22 - 0,55	0,95 - 13,90	5,58 - 13,84
Corylus avellana L.		2,4 - 5,93	0,14 - 0,38	1,42 - 13,64	6,7 - 28,52
Ligustrum vulgare L.		0,1 - 0,36	0,12 - 0,48	1,42 - 3,44	7,59 - 12,77
Rosa canina L.		1,83 - 2,95	0,22 - 0,4	3,89 - 5,65	6,64 - 11,7
Rubus caesius L.		1,42 - 2,27	0,1 - 0,33	1,18 - 15,2	7,31 - 7,4
Lians					
Hedera helix L.		0,68 - 3,32	0,1 - 0,58	1,45 - 12,9	8,3 - 22,11
Herbaceous					
Cynodon dactylon (L.) Pers.		0,21 - 0,99	0,19 - 0,52	2,8 - 3,3	5,39 - 17,16
Geum urbanum L.		1,23 - 8,32	0,17 - 0,93	2 - 23,5	14,51 - 66,94
Glechoma hederacea L.		0,69 - 0,94	0,21 - 0,38	2,23 - 3,22	10,98 - 17,68
Plantago lanceolata L.		1,2 - 2,97	0,15 - 0,69	2,84 - 3,76	7,3 - 10,43
Polygonum aviculare L.		0,25 - 1,18	0,19 - 0,32	2,42 - 3,6	15,53 - 16,40
Portulaca oleracea L.		0,56 - 0,87	0,2 - 1,02	1,28 - 1,75	6,38 - 13,35
Setaria viridis (L.) Beauv.		1,21 - 2,05	0,27 - 1,02	2,63 - 2,73	22,66 - 32,70
Taraxacum officinale Weber ex. Wiggers		0,94 - 3,26	0,1 - 0,22	0,26 - 6,82	3,90 - 13,6

* according to Pais and Jones Jr., 1996, for Pb and Cd, and Kalra, 1998, for Cu and Zn

A practical application of living organisms as bio-indicators for monitoring of environmental pollution has been observed for many years in various countries. Among medicinal species are mentioned dandelion *(Taraxacum officinale)* and black poplar *(Populus nigra)*. Using herbs in medical treatment of various illnesses people should be aware that apart from the pharmacological effect they can be also toxic because of the presence of heavy metals and other impurities. This phenomenon should be disseminated for people awareness, to prevent collecting medicinal herbs near communication routes (Baranowska et al., 2002).

Trees in Bucureşti parks are mainly cultivated and some are native but usually cultivated in parks, margins of the roads, green fens, etc. The heavy metal accumulation depends on their distance from the source of pollution (main boulevards) and their availability for metal uptake. The field observations revealed that the dryness percent of trees leaves is higher in young trees at the edge of major communication routes, with intense car traffic. The best bio-accumulators are the native trees and ruderal herbaceous.

Working interdisciplinary and multidisciplinary in the framework of LIFE AIR-AWARE project, we can stipulate that without an integrative research upon the city, the urban planning can fail very easily.

Human well-being and heath, sustainable development of the city, reduce loss of biodiversity, climate change influence of the local and regional level, depend on good environmental management and urban planning.

Everywhere on the globe, conditions for plants (and animals) have always changed and will always change!

The natural conditions, mainly physical nature, are rather slow. The current human induced changes are rather rapid, include chemical influences (CO2, soluble N, acid rain) as well as surface land management, causing unexpected impact.

The small changes in atmospheric and soil parameters produce changes in plant and animal populations and distribution and in their relationships with other plants and animals.

In the trophic network of an ecosystem any small change act like a “snow ball” which, without any doubt, affect us, human beings, much more.

At the national and international level, very important is the increasing contamination of the soil, water and atmosphere which affect all living beings.

The reduction of emissions is mainly a technical problem which can be solved by technicians and politicians. The task of the ecologists must be to recognize in time the penetration of ecosystems by hazardous substances, to evaluate changes in environmental quality and from the potential risk to organisms. Only hereby it is possible to introduce preventive and protective measures.

Monitoring of bioindicators should establish the most likely species to survive in the park under conditions of increasing pollution and other global changes. The park administration should be advised to use such bioaccumulators or plants resistant to pollution in the sowing, planting and management regimes. Public awareness about the pollutant concentration revealed by bioindicators can increase the pressure on administrative bodies to take measures to decrease the air pollution.

In Bucureşti, the parks from the central area have been studied in the period 2006-2008 (Onete at all, 2007, 2008). The biocoenoses in the city have urban character:

- more natural being remnants of the forests that lay once on Bucureşti city place: Codrii (Forests) Grazovestilor, Codrii (Forests) Cotrocenilor, (Forests) Codrii Lupestilor, etc
- the herbaceous layer have a large proportion of ruderal species

- the trees and shrubs are mainly cultivated, the native trees species number decreasing
- the communities changed their structure, dominating the more resistant species (xerophytes, bio-accumulators, etc)
- the maintenance of plant species in green spaces planned for human amenity has a high cost.

Recommendations

The studies were carried out as part of a project to enable people to become more aware of the health problems associated with air pollution and urban ecosystems degradation.

The development of the city and its satellites has resulted in massive forest clearance and the expansion in agricultural production. In nowadays, most of this land is unused and consequently it has attracted residential and retailer developers, amongst others. Small lakes and wetlands have been drained, the size of the forests patches has been reduced and as a result there have been significant changes in the landscape diversity, which have induced changes in the local climate.

Ornamental annual species have been planted in most of the parks and green spaces. The herbaceous layer is rich in ruderal species and in sown areas the dominant species are few and derived from seed-mixtures used by the parks administrations. Large populations of *Polygonum aviculare* and *Portulaca oleracea* have colonised the green spaces of the larger streets, are abundant and often dominant in areas with compacted, very dry and craked soil, where the grass species have vanished or are scarce.

The soil-moisture levels in the parks is low, the reason being that in the parks, the asphalt or concrete paths without vegetation and surrounding high circulated boulevards hit the atmosphere, increasing the water evaporation from the soil.

The natural tree and shrub vegetation of the city has mainly disappeared, being replaced by non-native species from China, Japan, America and other countries. There are still some remnants of the natural vegetation, which has adapted to the modified environmental conditions of the city, including nutrient status (eutrophic or oligotrophic), changes in soil pH and increased temperature and pollution. Most are non-native ornamental species. Saplings of *Ailanthus altissima* are abundant along the sides of many streets - it has become highly invasive species in recent years.

The native woody species present in the city include: *Acer platanoides, Acer pseudoplatanus, Acer tataricum, Berberis vulgaris, Betula pendula, Carpinus betulus, Celtis australis, Cerasus mahaleb, Cornus mas, Cornus sanguinea, Corylus avellana, Crataegus monogyna, Fraxinus excelsior, Hedera helix, Ligustrum vulgare, Populus alba, P. nigra cv. italica, P. tremula, Quercus cerris, Q. robur, Rosa canina, Rubus caesius, Salix alba, S. fragilis, Sambucus nigra, Tilia cordata, T. platyphyllos, Tilia tomentosa, Ulmus glabra* and *Ulmus minor.*

The recommendations include:

- Protection and restoration of biodiversity must be the number one task for diminishing the loss of native species

- Planning environmental management should rely on better knowledge of the particular vegetation and its dynamics from Bucureşti and plants species requirements, the history of the city vegetation cover.
- Use of any free space from the city for re-vegetation
- Re-vegetation and conservation should focus on native/indigenous species. In this way it can be kept the local identity of the city
- Keep the mature trees on the edges of the major traffic roads because they are more suitable to resist in urban environment. Usually they are cut down for not producing damages on parked cars.
- Any design of the urban landscape should have as focal point urban biodiversity protection
- Promoting the usage of small spaces: "green buildings", green roofs, retention ponds, swales, rain gardens
- Promoting of eco-friendly activities: solar heating, water harvesting and water management, waste recycling and compost facilities
- Public education and municipality contribution for making people aware about introduction of native species in their gardens

The biggest current problem for the Bucureşti authorities is to ensure a healthy environment for the people (in relation to identifying and controlling the multiple pollution sources that are seriously affecting the quality of the air, water and soil). However the authorities should not ignore the necessity of maintaining and increasing the green spaces of the city. The area of the city's green spaces has decreased in recent years. Some have been sold to the private sector for the development of hotels and commercial centres. Large new development projects are converting green spaces into retail and entertainment areas for people. More governmental and non-governmental organisations should fight for the preservation and enlargement of the green spaces in the city but with success.

The vegetation and flora of Bucureşti needs to be studied much more comprehensively in order to ensure that the planning, design and management of the city as a whole and the green spaces in particular are based on sound scientific information.

SUSTAINING OF DIVERSE AND ROBUST ARTHROPODS POPULATIONS IN URBAN GREEN AREAS

Mihaela Ion

Urban environments are systems controlled by man with a complex, dynamic, rapidly changing structure. Despite living in cities for a long time, we know very little about how cities function as ecological entities.

Urban ecosystems present a wide heterogeneity of habitats especially green spaces whether they are large park, public gardens, cemeteries, playgrounds, squares, personal gardens and lawns or even greened roundabouts. The heterogeneity is the result of many natural and human induced factors. A park could be entirely designed and planted or it could contain the remains of an older forest. It could cover a former vacant land or previous landfill incorporated now in the city borders.

The urban constructed area is in permanent change and it is extending its surface in the detriment of seminatural ecosystems in the vicinity. Most of the time, following the economic and social needs, the infrastructure and the buildings of a new area are occupying all the space, green areas being left aside, although it was demonstrated the positive effect of them onto the physical and psychical health of humans (Richard M. 2008, Thomas S.N. 2007, Gidlof G.A 2007). As the distance between residential zones and green areas increases, the benefits decrease, so sustaining the conservation of urban wild is not only worth for the intrinsic value of it but for the human health too.

In order to be able to manage in a sustainable way the existing green areas and to develop fully functional new ones it is imperative to know the biological structure of an urban park. Beside trees and other plants, a diverse fauna finds refuge in every corner of a green space. People are only aware of the most encountered, easy to see or hear animals, like some species of birds (pigeons, singing or aquatic birds), rodents (squirrels), lizards and frogs, but the food for all this is frequently constituted by small invertebrate invisible for the untrained eyes. We must be aware that these invertebrates live all around us, they might be on the branches and leafs of the trees, hiding and foraging in the grass or crawling beneath leaf litter in the soil. Even if are so small they play an important role in the trophic web of a park and also in maintaining a good soil structure.

Insects, acari, spiders, scorpions, and centipedes are groups of taxa belonging to the very diverse phylum *Arthropoda.* The arthropods species outnumber all other phyla combined, being the most diverse and abundant animals in natural ecosystems.

Arthropods present bilaterally symmetry and have a strongly segmented body both externally and internally. Some of the segments are fused to form the head, thorax and abdomen (Myers 2001). The articulated appendages (three, four or more pairs) are found on each segment but in the process of evolution some were strongly modified or lost.

The Charter on Invertebrates (Rec(86)10E 1986) describes clearly some of the strong, positive values of invertebrates (Table 1), and states that "*plant and animal life, primary productivity-plant-and secondary productivity - animal - depend directly and indirectly on the existence of a diversified invertebrate fauna and that, in consequence, the perenniality of it's existence is essential to the survival of mankind"*

Table 1 Important points of the Charter on Invertebrates (Council of Europe 1986)

1	Invertebrates are the most important component of wild fauna, both in number of species and biomass
2	Invertebrates are an important source of food for animals
3	Invertebrates may also constitute a source of food for mankind
4	Invertebrates are vital to the fertility and formation of the soil, and to the fertilization and production of the vast majority of cultivated plants
5	Invertebrates are useful in protecting farming, forestry, animal husbandry, human health and water purity
6	Invertebrates are valuable aids for medicine, industry and crafts
7	Many invertebrates are of great aesthetic value
8	Some invertebrates may harm human activities but their populations may be controlled naturally by other invertebrates
9	Mankind can benefit greatly from enhanced knowledge of invertebrates
10	Terrestrial, aquatic and aerial invertebrates should be protected from possible causes of damage, impairment or destruction

ARTHROPODS ROLE

Arthropods dominate de animal kingdom both in species number and production (biomass). Most of these species consumes and degrades the organic matter (plants or animal) releasing minerals necessary for the growth of the primary producers (plants) that provide not only products (food, clothing) but essential services as well (purifying water and air).

Large numbers of plant species cultivated for various reasons, even esthetic, benefit from arthropods pollination, some even depending on specialized species.

Predators as lady bugs (Coccinellidae), centipedes (Chilopoda), trips (Thysanoptera), ground beetles (Carabidae) are keeping under control populations of other invertebrates that can be harmful to crops or other plants grown mainly for

esthetic reasons. Other arthropods can diminish the problem of weeds or invasive plants by eating steams, leaves or even seeds.

Phytophagus, predators, parasitic or detritivore all arthropods are prey for a large number of vertebrates, some with great conservation values. So, in order to protect fish, amphibians, reptiles, birds and mammals, also arthropods, as an important element in the food chain must be also protected.

It must be understood that even if there are many arthropod species represented by a great number of individuals, the species, as preys are not always interchangeable as nutrients. "Many insectivorous vertebrates select, and depend on, a particular suite of prey taxa rather than just taking random prey" (New T.R. 1995)

The presence of invertebrates in soil prevents soil aridization and erosion. Arthropods improve constantly the structure of the soil. They can modify aeration, porosity and thus improving water passage. A more humid soil, not deprived by leaf litter, can sustain large population with an important role in humification (by recycling dead organic matter) that improves the availability of minerals in soil necessary for the development of the layers of vegetation. Thus, the input of additional fertilizers might be lowered in an urban green area.

Arthropods are not the annoying creatures that transmit diseases to humans, livestock and pets, or can destroy entire crops or the roses in a garden. These are only a small fraction of the species that can be found in soil, on small vegetation or in the tree canopy. Instead, most of the species are beneficial for humans and their activities. Their existence assure overall biological equilibrium not only in natural untouched ecosystems but also in urban environments.

Only some of the services provided by arthropods are well documented and even less attention has been given to the researches in urban habitats. Even if greatly disturbed by human activities, that destroys habitats, introduces exotic species of plants and animals and pollutes the water air and soil, urban parks are ecosystems that sustain a wide variety of species and benefits from the resources (as prey) and the services provided by them.

Arthropod species living in the vast heterogenic habitats available in cities are mostly ubiquitous, but rare species at national or local level might survive or even thrive here. Many of them have some adaptations that permit them to resist increasing temperature, frequent droughts and pollution episodes.

In order to develop an environmental management plan for the green areas, capable to maintain normal, functional arthropod populations, it is necessary to understand and put in practice some **GENERAL IDEAS**:

- Develop and maintain a high heterogeneity of habitats
- Encourage the use of native vegetation
- Extend irrigations practice
- Reduce insecticides use and adopt alternative control methods for insects
- Adopt measures to minimize trampling
- Develop green corridors

- Organize popularization events meant to put the urban human population (especially children) in contact with the diversity of urban fauna.
- Cooperate with researchers and develop projects meant to increase knowledge of urban ecosystems (structure and function)

The diversity of the available habitats greatly influences not only the structure of the invertebrate populations but also the services provided by them.

General practices tend to reduce habitat diversity by maintaining either a structure dominated by trees or open spaces with low height ornamental plants and mowed grass. Further more the areas with trees tend to be populated with young individuals, mature or old specimens being replaced. Dead wood and leaf litter are constantly gathered and removed mainly because esthetic reasons thus eliminating an important component of the ecosystem.

It is a usual procedure to mow the grass in green spaces leaving little if none high vegetation. That action reduces considerable the population of phytophagous invertebrates and the area no longer attracts insectivorous birds. A solution is to alternate mowed grass with patches of high, wild grassland. Grassland can be very attractive visually if it is planted with wild flowers (Figure 1), and can even attract pollinators.

Natural, undisturbed woodland are rich in dead wood (tree trunks and branches) that play a very important role in any healthy ecosystem, providing substrate and food for boring insects and fungi, shelter for a great variety of other invertebrates and assuring the success of may other vertebrate and invertebrates species. Old tree stands as well as new established ones within the borders of an urban area can be improved, with careful management, in order to enhance the biodiversity and provide suitable habitats. Dead wood may play a major role in pursuance of this goal. Fallen deadwood must be left were it falls or as close of possible to ease invertebrates access. Cut or fallen branches can be gathered under the crown of some trees, and old trees, even if presents root holes, must be left standing if does not present the danger of falling over alleys. In more visited places a fallen trunk may not look acceptable but ways of using it in a garden architecture might be found. For example it can be used as material for sculptures (figure 2) or as flower-trough.

Leafs falling from trees are accumulating at soil surface creating a layer of leaf litter. At this level the processes are very dynamic, small animals and microorganism working as a whole and releasing the nutrients in the soil from were it can be absorbed by plants. A soil rich in organic matter can sustain a great variety of invertebrates.

In urban areas, leaf raking was developed in order to expose green lawns or to minimize ticks population. But this practice is more an aesthetic choice, which ignores all the benefits of retaining a leaf layer (Table 2) that, among other things, protects the soil, seeds, plant roots and soil fauna from freezing.

So, maintaining leafs eliminates damage to soil, reduce the need for fertilizers and assure a friendly, moist environment for many beneficial invertebrates.

Table 2: Benefits of maintaining the dead vegetal organic matter (leaf litter) within the borders of the urban parks.

1	Food for the invertebrates living in soil , for microorganism and fungi
2	Protects soil from freezing in the cold season, maintaining seeds, plant roots and invertebrates viability
3	Create a hospitable environment for beneficial insects, birds, and other wildlife
4	Reduce the changes and protects the soil from pH modifications (becoming more acid or alkaline)
5	Protects the soil layer from wind and water (impact of the raindrops) damage reducing the erosion
6	Cycling of the nutrients is maintained
7	Plant nutrients is stored in soil
8	The structure of the soil is improved
9	Reduce soil compaction
10	Water infiltration is increased reducing the effect of torrential rainfall.
11	The water holding capacity of soil is improved. Less irrigation is needed.
12	Allows the plants to develop at their full capacity by providing a healthy soil and the necessary nutrients without additional fertilizers
13	Acts like a carbon sink. Retains dust and pollutants.

In places were it is possible, native grass species, shrubs and trees should be used. Even if non-native species might be more resistant to the urban stress it is possible to be colonized by only a bunch of invertebrate species producing imbalance in population structure. Native species can offer a greater stability and complexity to the ecosystem.

In a modified environment as the city, temperatures often rise above the regional average and droughts are frequent. Irrigations are often needed as the soil is prone to degradation (Figure 3)

Insecticides are rarely specific and can damage beneficial invertebrates as well as vertebrates. Attracting insectivorous birds, by providing secluded areas with shrubs and trees for nesting and resting can be an alternative.

Fences and hedges around large areas, delimiting alleys can reduce trampling. Soil is compacted in usually trampled zones and the diversity of both flora and fauna is reduced.

Figure 1: Recreational area with mowed grass alternating with wild flower grassland. (Toulouse, France) (foto Mihaela Ion)

Figure 2: Tree trunk carved as a sign for the zoo in an urban park (Lille, France) (foto Mihaela Ion)

Figure 3: Damage to soil due to drought in an urban park,
without irrigation (foto Mihaela Ion)

Figure 4: Vegetation is allowed to settle along the main river Garrone
in Toulouse, France. (foto Mihaela Ion)

Green corridors running along main roads or/and rivers (Figure 4) help to maintain the connection between urban green areas. This can be beneficial both for vertebrates, that can move to find a more suitable food source, and for invertebrates, boosting the urban biodiversity.

Tree planting or urban biodiversity discovery campaigns run in parks and other urban green areas, with population and especially children involvement, can lead to a better understanding of the complexity of nature and the services it provides to the city. This way, the world of invertebrates can gain a lot of friends. Thus, biodiversity conservation programs, even those aimed to less known fauna, can gain a large group of supporters, as much of the human population live in urban areas.

No management plan can be efficient if it is not sustained by long term ecological research capable to observe the effects of different management approaches on urban diversity. This kind of research can observe the changes affecting flora and fauna and warn about potential impact on human population.

NECESITY OF BIRDS CONSERVATION IN THE CITY

Ioana Cobzaru

Urban natural areas are very important components of a city's infrastructure. Parks and gardens enrich the lives of citizens, offering places to watch wildlife, to rest and reduce the stress, they work as vegetative buffers, have an important role in reducing air pollution, in water conservation and more. Evidence shows that urban natural areas reduces anxiety and stress, even helps lower crime and violence.

The loss of natural land in favour of urban areas has resulted in the diminution of the natural habitat and biodiversity of species. Large parks, however, play an important role in the urban landscape. Research shows that park management regimes and the variety of park habitat can affect the abundance, diversity and composition of native bird species found in large city parks (European Commission, 2008).

Wildlife conservation in urban habitats is increasingly important due to current urbanization trends. We have created attractive urban greenspace environments with our parks and gardens. These greenspaces have been created not so much for wildlife habitats as for people to enjoy, but the potential for wildlife habitat exists in these scattered habitat patches. An effective planning strategy is needed to **create and link** these isolated patches because the **fragmentation of habitats** is one of the most important causes of wildlife decline in urban areas.

In Bucureşti the rate of urban development continues to increase. As the town expands, natural vegetation is cleared and replaced with buildings and related infrastructure, leaving the wild birds unable to adjust to this new habitat. This loss of biodiversity as a consequence of urbanisation is of great concern, and if we can't recreate the natural ecosystem we can try to make urban habitats more suitable for a range of species.

Birds are often used as indicators for the health of ecosystems (ex. bioindicators). Since a diverse ecology is needed to support a great number of species, a lower number of species in an environment indicates lower ecological health and a poor quality of habitats.

Birds are particularly good as **environmental indicators** because they:

- are easy to see and observe
- live in almost every type of environment and occupy many different niches
- are often at the top of the food-chain and are therefore very vulnerable to accumulating chemicals
- depend on the full range of animal and plant diets

Birds can also be used in environmental education. Many of the bird species that visit urban areas are highly valued by the general public and is only a small step to create a collective sense of responsibility to ensure their survival.

The necessary condition for birds survival are easy to understand. First of all they need to feel safe in their environment, all birds need food and water, shelter and a place to nest. Most of these requirements can be met by a suitable vegetation, even if is a large tract forest or a natural urban area. In a fragmented environment the size

of these habitat patches, and their connectivity to one another, is also important because birds need to travel long distances to find mates, avoid predators and search for food. The habitat requirements are depending upon the species of bird.

Urban birds

The birds that use urban areas can be categorised in two groups, by their ability to live in the types of urban habitats:

• *Urban specialists* are birds that are now more common in urban environments than in their traditional habitats. They include species like House Sparrow (*Passer domesticus*), Feral Pigeon (*Columba livia domestica*) and Collared Dove (*Streptopelia decaocto*).

• *Urban generalists* are birds that use both urban and natural habitats. They usually depend on natural habitats (forests, shrubs, wetlands) but can also occur in urban habitats. However, they vary in abundance and, are thought to be in decline. These are the species within urban habitats (particularly gardens and parks), for which efforts should be made to secure their populations. They include small insectivores species like Great Tit (*Parus major*), Blue Tit (*Parus caeruleus*) or granivores like Chaffinch (*Fringilla coelebs*), Goldfinch (*Carduelis carduelis*), woodpeckers, swallows, ducks, etc.

In Bucureşti, an impressive number of species are observed all year round, some of them residents, summer visitors or winter visitors.

GREBES (Ord. Podicipediformes - Fam. Podicipedidae)
- Great Crested Grebe (*Podiceps cristatus*)
- Little Grebe (*Tachybaptus ruficollis*)

CORMORANTS (Ord. Pelecaniformes - Fam. Phalacrocoracidae)
- Great Cormorant (*Phalacrocorax carbo)*

HERONS (Ord. Ciconiiformes - Fam. Ardeidae)
- The Night Heron (*Nycticorax nycticorax*)
- Great Egret (*Egretta alba*)
- Grey Heron (*Ardea cinerea*)

SWANS (Ord. Anseriformes - Fam. Anatidae - Subfam. Cygninae)
- Mute Swan (*Cygnus olor*)

DABBLING DUCKS (Ord. Anseriformes - Fam. Anatidae - Subfam. Anatinae)
- Mallard (*Anas platyrhynchos*)
- Gadwall (*Anas strepera*)
- Wigeon (*Anas penelope*)
- Teal (*Anas crecca*)
- Garganey (*Anas querquedula*)
- Shoveler (*Anas clypeata*)
- Pintail (*Anas acuta*)

DIVING DUCKS (Ord. Anseriformes - Fam. Anatidae - Subfam. Aythyine)
- Pochard (*Aythya ferina*)
- Red-crested Pochard (*Netta rufina*)
- Ferruginous Duck (*Aythya nyroca*)
- Tufted Duck (*Ayhya fuligula*)

BIRDS OF PREY (Ord. Falconiformes - Fam. Accipitridae and Fam. Falconidae)
- Common Buzzard (*Buteo buteo*)

The Hobby (*Falco subbuteo*)
Common Kestrel (*Falco tinnunculus*)

RAILS (Ord. Gruiformes - Fam. Rallidae)
The Coot (*Fulica atra*)
The Morhen (*Gallinula chloropus*)

WADERS (Ord. Charadriiformes - Fam. Charadriidae and Fam. Scolopacidae)
The Lapwing (*Vanellus vanellus*) (Figure 1.)
Little Ringed Plover (*Charadrius dubius*) (Figure 2.)
The Common Snipe (*Gallinago gallinago*)
Green Sandpiper (*Tringa ochropus*).

GULLS (Ord. Charadriiformes - Fam. Laridae)
Larus michahellis (Figure 3.)
Larus cachinnans
The Black-headed Gull (*Larus ridibundus*) (Figure 4.)
The Common Gull (*Larus canus*).

OWLS (Ord. Strigiformes – Fam. Strigidae)
Little Owl (*Athene noctua*)
Long eared Owl (*Asio otus*)
Tawny Owl (*Strix aluco*)

SWIFTS (Ord. Apodiformes **-** Fam. Apodidae)
The Swift (*Apus apus*)W

WOODPECKERS (Ord. Piciformes - Fam. Picidae)
The Green Woodpecker (*Picus viridis*) (Figure 5.)
Great Spotted Woodpecker (*Dendrocopos major*)
Syrian Woodpecker (*Dendrocopos syriacus*) (Figure 6.)

LARKS (Ord. Passeriformes **-** Fam. Alaudidae)
The Crested Lark (*Galerida cristata*)

SWALLOWS (Ord. Passeriformes **-** Fam. Hirundinidae)
The Barn Swallow (*Hirundo rustica*)
House Martin (*Delichon urbica*)

PIPITS and WAGTAILS (Ord. Passeriformes **-** Fam. Motacillidae)
White Wagtail (*Motacilla alba*)
Grey Wagtail (*Motacilla cinerea*)
Yellow wagtail (*Motacilla flava*)
Water Pipit (*Anthus spinolleta*)

The **WREN**, *Troglodytes troglodytes* (Ord. Passeriformes – Fam. Troglodytidae)

The **STARLING** (*Sturnus vulgaris*) (Ord. Passeriformes - Fam. Sturnidae)

CROWS (Ord. Passeriformes - Fam. Corvidae)
The Magpie (*Pica pica*)
Jay (*Garrulus glandarius*)
Jackdaw (*Corvus monedula*)
Hooded Crow (*Corvus corone cornix*)

WARBLERS (Ord. Passeriformes - Fam Sylvidae)
The Blackcap (*Sylvia atricapilla*)
Lesser Whitethroat (*Sylvia curruca*)
Willow Warbler (*Phylloscopus trochilus*)
Chiffchaff (*Phylloscopus collybita*)

FLYCATCHAERS (Ord. Passeriformes - Fam. Muscicapidae)
Collared Flycatcher (*Ficedula albicollis*)

THRUSHES (Ord. Passeriformes - Fam. Turdidae)

The Black Redstart (*Phoenicurus ochruros*) (Figure 7.)
Robin (*Erithacus rubecula*)
Nightingale (*Luscinia megarhynchos*)
The Common Blackbird (*Turdus merula*)
Song Thrush (*Turdus philomelos*)
Mistle Thrush (*Turdus viscivorus*)
Fieldfare (*Turdus pilaris*) (Figure 8.)

TITS (Ord. Passeriformes - Fam. Paridae)
Blue Tit (*Parus caeruleus*) (Figure 9.)
Great Tit (*Parus major*)
Long-tailed Tit (*Aegitalos caudatus*)

NUTHATCHES (Ord. Passeriformes - Fam. Sittidae)
Tha Nuthatch (*Sitta europaea*)

The **TREECREEPER**, *Certhia familiaris* (Ord. Passeriformes - Fam. Cerhiidae)

SPARROWS (Ord. Passeriformes - Fam. Passeridae)
House Sparrow (*Passer domesticus*)
Tree Sparow (*Passer montanus*)

FINCHES (Ord. Passeriformes - Fam. Fringillidae)
Chaffinch (*Fringilla coelebs*) (Figure 10.)
Brambling (*Fringilla montifringilla*)
Green Finch (*Carduelis chloris*) (Figure 11.)
Goldfinch (*Carduelis carduelis*) (Figure 12.)
Siskin (*Carduelis spinus*)
Bullfinch (*Pyrrhula pyrrhula*)
Hawfinch (*Coccothraustes coccothraustes*)

What influence most birds diversity?

Landscape connectivity

Connectivity is an important issue in urban landscapes. Habitat fragmentation and loss of habitats are the main causes of species decline. Birds need to travel between natural patches to find mates and search for food, but if these are isolated it will affect the diversity of species. The small size birds are first to be affected, especialy the ones who are not urban specialists and depend on woodland vegetation. Scientists put in evidence that in cities, vegetation strips act as corridors for some birds (Fernández-Juricic 2000a; Fernández-Juricic 2001b). The wooded streets with complex habitat structure positively influence the number of species present within wooded streets, as well as species persistence, guild densities, and the probabilities of occupation by individual species (Fernández-Juricic 2000a).

- Wooded streets allow certain species (particularly those feeding on the ground and breeding in trees or tree holes) to remain in city by providing alternative habitats during the breeding season.
- Small parks could play a significant role in the connectivity of urban landscapes.
- Before development the city infrastructure, maximize open space and make an effort to protect the most valuable wildlife habitat by placing buildings on less important portions of the site (avoid the loss of natural areas)

Habitat structure

Generally, urban parks have lower vegetation cover as compared to more natural areas, even lacking some vegetation layers at all. Several studies show the importance of preserving habitat complexity to increase bird diversity in urban parks (Jokimäki 1999; Savard et al. 2000).

- Trees of different ages as well as multiple layers of vegetation are the most simple and direct tools to increase the suitability of urban parks due to a higher availability of food, shelter and breeding substrates (Fernández-Juricic E, Jokimäki J., 2001).
- Preservation of primary habitats is very valuable for bird conservation, since they allow the presence of certain native species without special adaptations for the urban life.
- Mixed species forests (deciduous and coniferous) enlarge bird diversity in urban settings more than single species forest stands (Thompson et al. 1993, Fernández-Juricic E. et al., 2001): more species with different habitat requirements can use a diversity in floristic composition. Use native plants that have value for wildlife as well as aesthetic appeal.
- Maintain a screen of vegetation on the ponds' shore to assure a shelter and a nesting place for the waterbirds.
- The availability of different kinds of nest-boxes and bird-feeding stations may increase the colonization of urban parks by a great variety of cavity-nesting birds (Jokimäki 1999).
- Permanent and clean water sources are important for bird diversity (Jokimäki 1992, Fernández-Juricic E. et al., 2001), they attract a group of rare species not usually seen in urban parks. For example, in Bucureşti, rare birds like *Gavia arctica* is using Morii Lake to rest and feed during migration, also other species of dabbling and diving ducks are wintering on the lakes inside parks, Grey Wagtail who is a mountain species comes in winter to urban parks with artificial streams and small ponds and the exemples continues.

Human disturbance

Besides fragment size, isolation, and habitat structure, urban bird species may also be affected by human disturbance (Blair 1996; Fernández-Juricic and Tellería 2000; Fernández-Juricic 2000b). At a regional scale, the rate of visitors to urban parks in Madrid diminishes species richness as well as the temporal persistence of breeding pairs (Fernández-Juricic 2000b). In this situation:

- The residents must be educate about wildlife conservation, using, for example, information packets or a nature trail through open space.
- Seek ways of combining habitat conservation with other community goals, such as establishment of public recreation lands, open space, and water quality protection.
- Protect the nesting places from the parks, especialy for the ground-nesting species like Mallard. The curiosity and often badintention of people can destroy the chances to breed for the birds.
- Build retreat spaces for the waterbirds, like the platforms or ornamental rocks in the centre of the ponds.

Figure 1. *Vanellus vanellus* (Foto Paul Țibu)

Figure 2. *Charadrius dubius* (Foto Paul Țibu)

Figure 3. *Larus michahellis* (Foto Paul Țibu)

Figure 4. *Larus ridibundus* (Foto Dorin Damoc)

Figure 5. *Picus viridis* (Foto Paul Țibu)

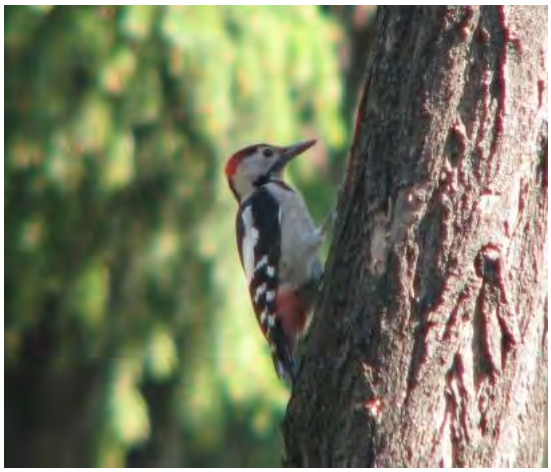

Figure 6. *Dendrocopos syriacus* (Foto Paul Țibu)

Figure 7. *Phoenicurus ochruros* (Foto Paul Țibu)

Figure 8. *Turdus* pilaris (Foto Dorin Damoc)

Figure 9. *Parus caeruleus* (Foto Paul Țibu)

Figure 10. Fringilla colebs (Foto Dorin Damoc)

Figure 11. *Carduelis chloris* (Foto Paul Țibu)

Figure 12. *Carduelis carduelis*(Foto Paul Țibu)

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